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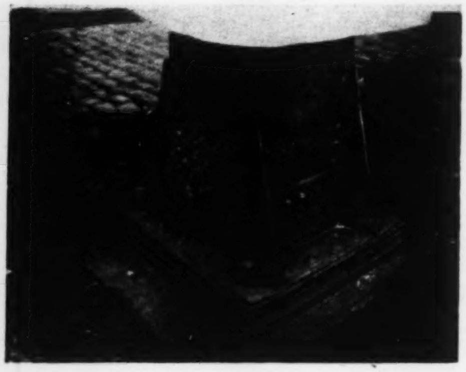

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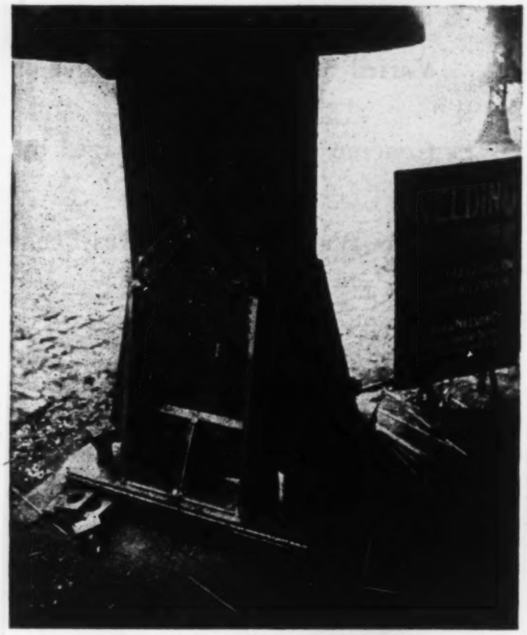

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Varied Steel-Erection Practice on New Jersey Viaduct

Three miles of truss spans on high-level structure on Holland Tunnel approach highway in New Jersey erected by four contractors, using different equipment and procedure—Two 550-ft.-span cantilever river crossings in one of the contracts

AS VARIED a picture of steel-bridge truss erection as one is likely to encounter on a single project was presented during the construction of the long High-Level Viaduct over the New Jersey Meadows on the approach highway to the Holland Tunnel, which was opened to traffic on Nov. 24, 1932. This structure, stretching for nearly 3 miles at such a height as to provide 135-ft. vertical clearances over the Hackensack and Passaic Rivers, is made up, with the exception of the river crossings, of deck-truss spans varying in length from about 175 to about 350 ft. Bearings on the piers are alternately fixed and free, and alternate spans carry suspended portions. Curved lower chords are used for all of the spans of the viaduct.

Four steel contractors were engaged on the work, constructing the sections indicated in Fig. 4. In general, each contractor was confronted with the same task, but no two chose the same method of attack. Equipment and procedure varied on each section. For example, on the section immediately east of the Hackensack River, locomotive cranes set most of the steel from the ground. Timber tower falsework was used, four bents in each anchor arm span, and one, two or none were used in the suspended spans. On the eight-span section extending west from the Hackensack River, mobile towers, 120 ft. high, running on tracks either side of the viaduct and carrying stiff-leg derricks on top, erected the steel. Five steel bents, with H-section legs, were used as falsework under each anchor arm span and three under each suspended span. For the nine spans immediately west of

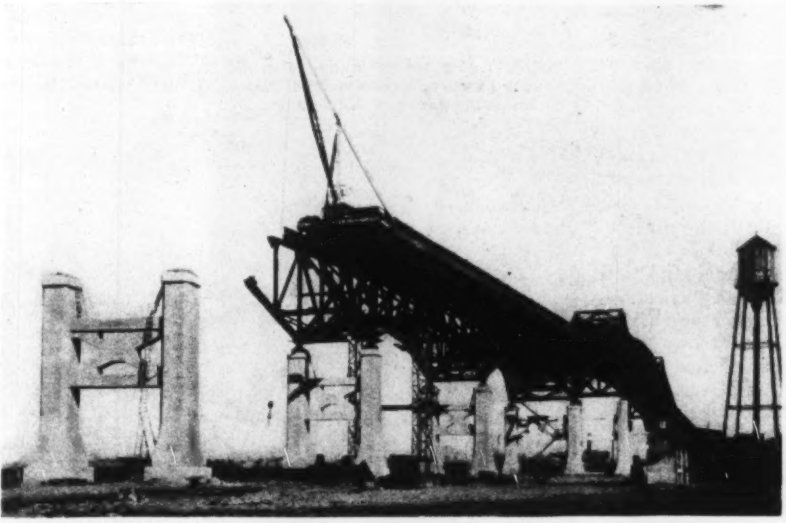


Fig. 1—Section west of Passaic River span was erected by Taylor-Fichter Co. with deck travelers assisted by crawler cranes on the ground.

this section a deck traveler picked steel from cars brought in on a temporary track laid on the center line under the bridge. Two steel bents with K-braced panels and H-section legs were used for falsework in each span. The fourth contractor, in erecting the eleven arch spans at the west end of the viaduct, also used deck travelers, but he supplemented them with crawler cranes on the ground and adopted a straight cantilever method of erection, using only one falsework bent in a span. Each leg of these bents was a square tower.

On all of the sections the falsework was adjustable in height, inasmuch as most of the viaduct is on a grade. For camber adjustments, and for aid in swinging the trusses free from the falsework, wedges, hydraulic jacks and sand jacks were variously used. The deck-truss spans in the viaduct involved a total of 68,000 tons of structural steel. In addition, each of the cantilever river crossings required 8,650 tons.

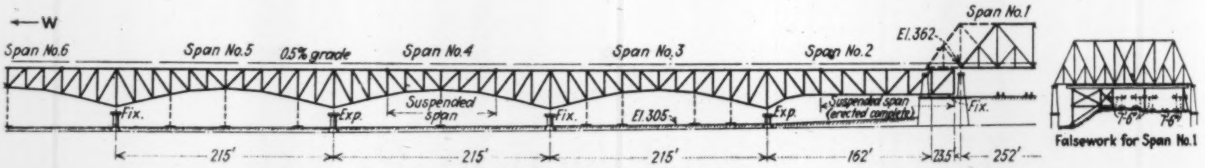


Fig. 2—Falsework locations on the American Bridge section. Cantilever trusses, with alternate spans carrying suspended portions, are typical for the full length of the viaduct.

The viaduct closes a gap in the through highway (route 25), leading from the Holland Tunnel west and south to Elizabeth and bypassing Newark. At the east end, in Jersey City, it connects at Tonnelle Circle with a viaduct and subway section completed some years ago (*ENR*, Jan. 5, 1928, p. 4); and on the west end, with an elevated highway, with no grade crossings, leading south past the Newark airport. The total length of the construction is, as stated, about 15,000 ft. Two ramps, one east of the Hackensack River and the other between the Hackensack and Passaic Rivers, provide access to and from surface streets in the industrial areas of the Meadows. Another ramp, at the west end, connects with streets in Newark. In general, two trusses are used, 36 ft. on centers, although at points where the structure is widened to accommodate ramps three and four trusses are necessary.

Throughout the length of the project the soil structure consists of layers of mud over clay and sand, mixed sand and gravel, with bed rock at depths varying from 25 ft. at the Hackensack River to a maximum of 141 ft. at one point between the two rivers, thence rising to 70 ft. at the Passaic River. This condition, which made foundation construction for the piers a major task, also added to the steel erection difficulties, particularly with reference to steel transportation and falsework supports.

The viaduct was designed and built by the New Jersey state highway department. The highway between Jersey City and Elizabeth was conceived and initially planned (with low-level movable spans over the rivers) by and during the administration of William G. Sloan, then state highway engineer, with Fred Lavis in charge of the Jersey City office. All studies, surveys, preparation of plans and specifications, as well as the supervision of construction, was directly handled by this office. For the final project with high-level river crossings, the direction of surveys, general supervision of design, preparation of contracts and specifications and supervision of the construction was under the direction of H. W. Hudson. Design details of the viaduct structure were in charge of Sigvald Johanneson. All of the work was under the general supervision of Jacob L. Bauer, the present state highway engineer.

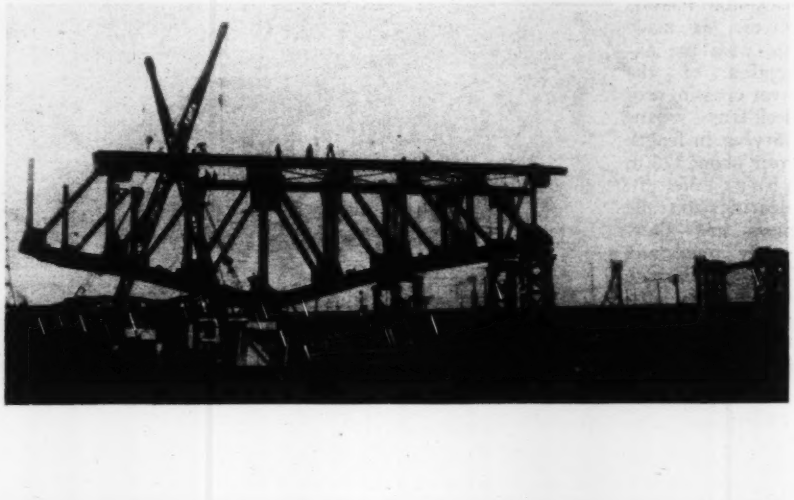
American Bridge section

The contract held by the American Bridge Co. started with a 252-ft. skewed through span over the Pennsylvania Railroad and Hudson & Manhattan Railroad tracks in Jersey City and extended westward to the Hackensack River in nineteen deck-truss spans. A ramp, rising from east to west, was located under six of the spans near the center of the contract. These spans are four trusses wide. Elsewhere the viaduct in this contract is two trusses wide. A total of 23,000 tons of steel was required.

Deck Trusses—The initial operation of the erection scheme used was to parallel the line of the bridge with two standard-gage railroad tracks, one on either side. These tracks were laid on a 7-ft.-high fill which had been built by the highway department with borrowed material during the period of foundation construction when the original ground proved too marshy to support the construction equipment. Steel was then brought in on cars by dinkey locomotives and, so far as most of the main material was concerned, was lifted direct from the cars to its place in the bridge by locomotive cranes. These cranes, of which there were five, had a capacity of 60 tons each and booms 85 to 110 ft. long. They erected the main trusses and enough of the floor beams and bracing to stay the structure until a 30-ton traveler with a 90-ft. boom working on the deck could fill in the remaining floor steel and bracing. An exception to this method of erection occurred on the four spans at the west end of the work, connecting with the high-level bridge over the Hackensack River. These spans, being too high for the locomotive cranes, were erected by the deck traveler.

Typical falsework layouts are shown in Fig. 2. Bents consisted of two timber towers about 8 ft. square, one under each truss (Fig. 3), tied together by wire-rope X-bracing. Hydraulic jacks were placed on the tops of the falsework bents for span adjustment. With the exception of the six spans in the ramp section, where piling was required because of the heavy load and an unusually soft ground condition, falsework was supported on 12x12-in. mud sills. Falsework layout varied

Fig. 3—Timber towers in the falsework bents and locomotive-crane erection characterized the American Bridge section.



somewhat in the different spans either as a result of foundation conditions or to clear obstructions. In general, however, either three or four bents were used in each anchor span, and either one or two bents in each suspended span. Erection began at the east end of the work and proceeded west.

The basic erection scheme was to erect two fixed or anchor spans first and then to erect the suspended span between. Thus, in starting out the work, spans 3 and 5 were first erected followed by spans 4 and 2. Then span 7 was erected followed by 6, etc. On an anchor span, locomotive-crane procedure was to erect the bottom chords and bottom laterals first and then fill in the web system and the top chords at the ends. The center section of the span was assembled last. For the suspended spans in which a single falsework bent was used, cantilever arms were erected out from either end, the bent set up directly beneath the center of the span and the suspended portion hung in two halves. Where two bents were used in the suspended span, the east half of the span and half the suspended portion were erected as a cantilever; then one falsework bent was placed at the center and another three panels from the west end, and the span was completed. A variation from both these procedures occurred in suspended spans where no falsework was used, the suspended portion of the trusses being assembled on the ground and lifted into place complete, using two locomotive cranes.

The six spans affected by the ramp were four trusses wide, the structure being about 90 ft. wide over all. For erecting this section of the viaduct, falsework bents were first placed under the two south trusses, which were erected with a locomotive crane. The falsework was then shifted to the opposite side of the structure, where two other locomotive cranes erected the two north trusses. The deck traveler filled in the floor steel and bracing as before, and in addition erected all of the steel for the ramp structure underneath.

As many as 32 riveting gangs were used on this contract at one time. A pressure of 135 lb. was provided for the riveting hammers, air being supplied from two compressor plants, one near the east end of the work and the other at about the center. In the east compressor plant three oil compressors, with an aggregate capacity of about 1,000 cu.ft. per minute, were utilized. At the central compressor plant there were two portable compressors and one oil compressor supplying about 700 cu.ft. per minute. At each of these plants, as well as at intermediate points along the work, air receivers were installed. Booster-pump plants lifted the air up to the deck and forced it along the pipe line to these receivers.

Railroad Truss—Although quite distinct from the deck-truss erection, work on the through truss span over the railroad tracks at the east end of the contract is worthy of note. Three or

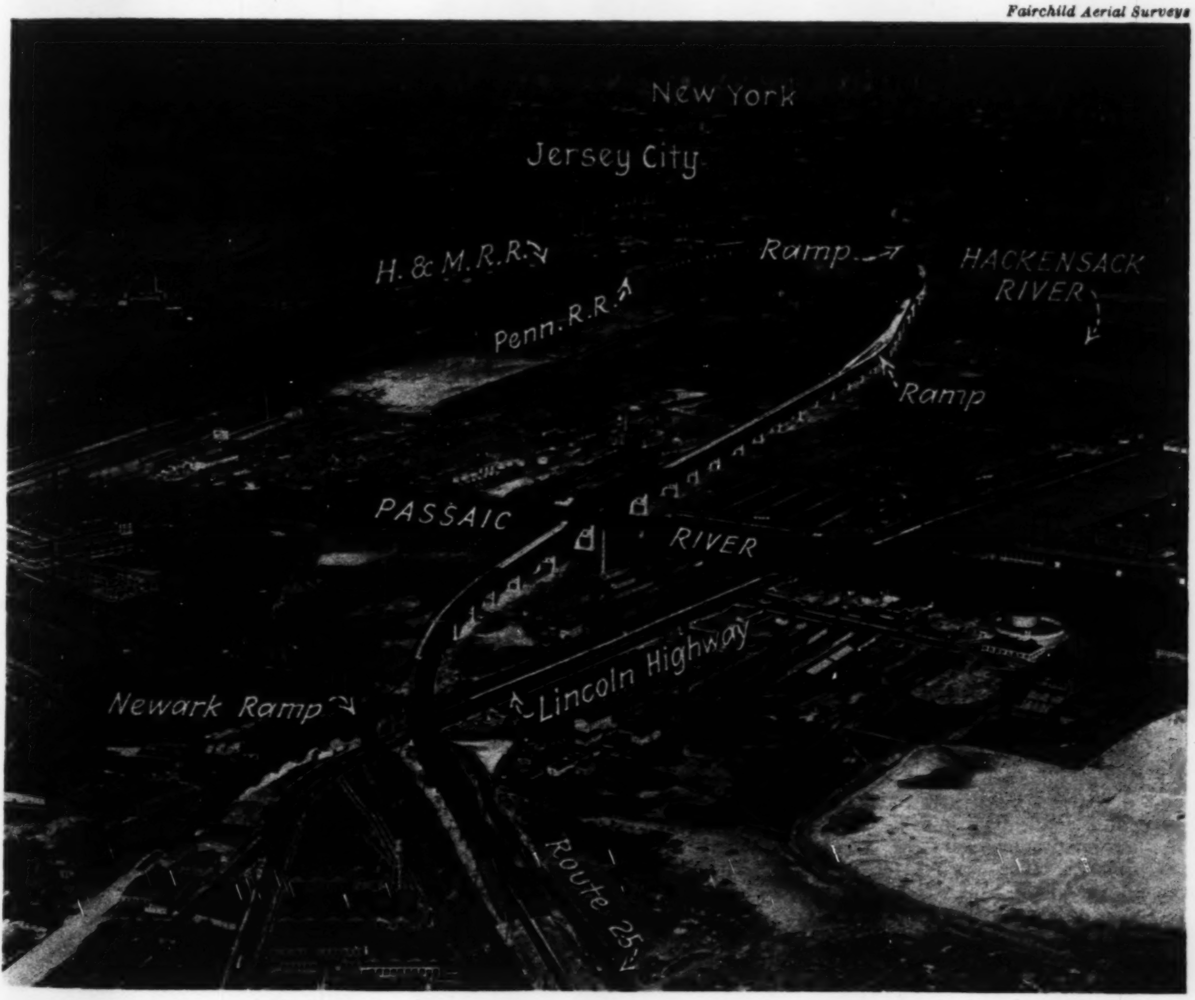


Fig. 4—Viaduct 3 miles long over New Jersey Meadows. The sections built by the four steel contractors are: Taylor-Fichter, Jersey City end to the skew span over the Pennsylvania and the Hudson & Manhattan railroad tracks; American Bridge, the skew span over the H.&M. and the P.R.R. tracks and the 19 deck-truss spans west to the Hackensack; McClintic-Marshall, Hackensack River cantilever span; Phoenix, 8 deck-truss spans west of the Hackensack; McClintic-Marshall, 9 deck spans west of the Phoenix contract and the Passaic River cantilever span; Taylor-Fichter, deck spans west of the Passaic River, including the Newark ramp in the left foreground.

Fairchild Aerial Surveys

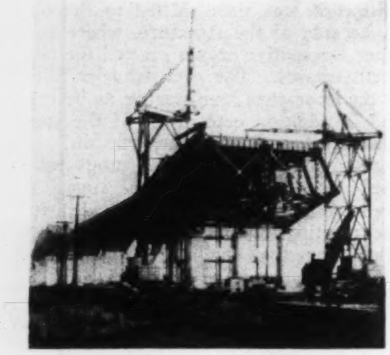


Fig. 5—Widening the viaduct to accommodate ramps required three trusses and in some places four instead of the two used elsewhere. View is on Phoenix Bridge section just west of Hackensack River bridge.

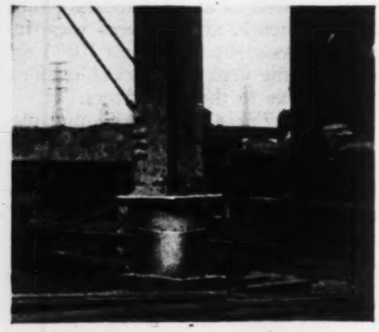


Fig. 6—Sand jack used under steel falsework bents on Phoenix Bridge section to adjust span and to swing it free when completed.

four spans of the deck-truss structure had been completed before the railroad span work was started. At the beginning, two 30-ton stiff-leg travelers with 90-ft. booms were assembled on span 3 by the locomotive cranes. One of these travelers, as previously noted, moved westward, placing the floor steel and top bracing in the deck trusses. The other traveler moved east to erect the railroad span.

A considerable skew in the span and the presence of the railroad tracks made uniformly spaced falsework impossible. Four bents of timber were utilized (Fig. 2), placed parallel to the railroad tracks. Two of these lines of falsework were set outside the track area on the west edge of a fill, and one was outside the track area on the east edge of the fill. The fourth bent was located between the tracks of the Hudson & Manhattan Railroad and those of the Pennsylvania Railroad. The exterior bents could be braced as towers, but this was not possible for the bent between the tracks, which consisted of a single line of columns tied together longitudinally at the top by cap timbers. The entire falsework system was tied together transversely by groups of heavy girder beams, which supported the trusses of the span at every second panel point. The result was an unusual layout in which neither the longitudinal nor transverse falsework caps were parallel to either the trusses or the floor beams of the span.

The erection traveler operated at one side of the center line of the bridge, while the other side was occupied by a narrow-gage material track upon which steel was brought out to the traveler on push cars. Because of this location of the traveler it fouled the web members of the trusses and thus could only place them as it was backing up. Accordingly, in erecting the span the first operation was to place the bottom chords and the floor system entirely across the structure. Then on the reverse movement of the traveler the web members, top chords and top bracing steel were placed.

For the American Bridge Co. the erection was under the general charge of J. B. Gemberling, eastern division erecting manager, with Dan McQuarrie as foreman and D. F. Fine as resident engineer.

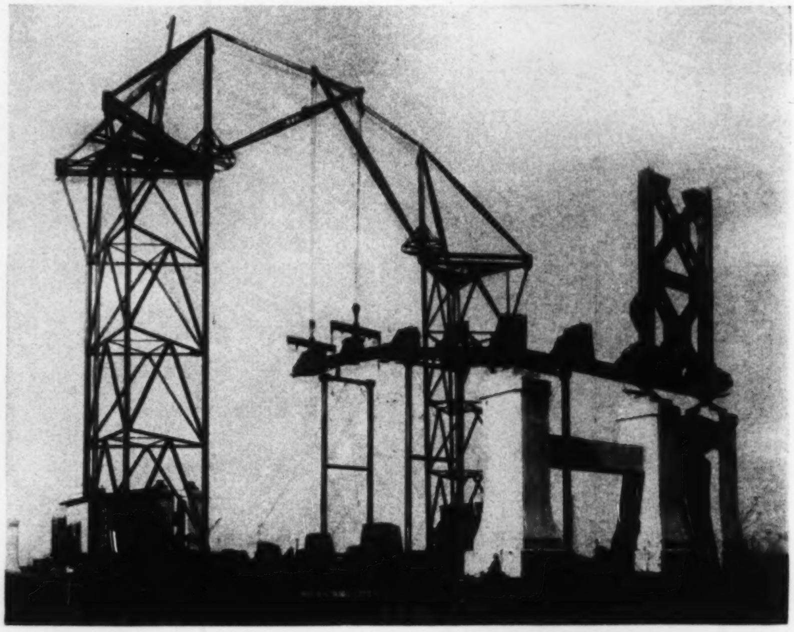
Phoenix bridge section

The portion of the work included in the contract of the Phoenix Bridge Co., extending from the Hackensack River west for about 2,400 ft., included eight deck-truss spans, with a maximum span length of 325 ft. and an average of 297 ft. The maximum height of the structure above the ground on this section was 128 ft. In general, the design was of the two-truss type but, because of a ramp, some spans utilized a three-truss and some a four-truss arrangement. Because of this varied construction the contractor decided to use ground travelers (Fig. 7) rather than a traveler on the deck of the structure. The only exception was that the suspended span connecting the first span with the Hackensack River bridge was erected with a light deck traveler, since the span was over the water.

The ground travelers, of which there were two, consisted of triangular towers 122 ft. high carrying 40-ton stiff-leg derricks with 75-ft. booms. Each tower was mounted on four standard-gage steel trucks, two traveling on an inside track placed close to the viaduct structure and two on an outside track 28½ ft. distant. Because of the shoulders of a fill covering the viaduct right-of-way, it was not possible to place the inside track as close to the piers as was desired, and this condition made heavy counterweights necessary at the bottom of the towers to resist overbalancing effects. The power for each derrick was supplied by a 10x12 three-drum hoisting engine located in the base of the tower. The towers were made self-propelling by the use of a set of double blocks with a 1½-in. line. With this arrangement it was possible to move a tower the full length of a span in about 5 min. Fully equipped, each tower weighed about 225 tons.

Falsework included five bents for each anchor span of the cantilever construction and three bents for the suspended spans. Inasmuch as there was one falsework leg under each truss, in the two-truss layout each bent contained two falsework legs of rolled H-section members, in the three-truss layout three legs, and in the four-truss layout four legs. For truss adjustment the bents were supported on sand jacks (Fig. 6) resting on I-beams on timber grillage footings. Attachments were also provided for hydraulic jacks to be used in raising the trusses if this should prove necessary. The general plan was to set the falsework bents considerably above the required elevation, to provide

Fig. 7—Mobile-tower travelers erected the steel on the Phoenix Bridge section.



for settlement and for removal of the falsework in swinging the spans.

Erection started at the fixed end of the anchor span at the east end of the section. Falsework bents, bottom chords and bottom laterals were erected complete between the piers for this span, the chords acting as the longitudinal bracing for the tops of the bents. On the return movement of the traveler the web members were placed, or in some instances the web members, top chords and top laterals. On the third pass of the travelers the floor and railing were erected. The arrangement was sufficiently flexible, however, and the movement of the travelers was so readily accomplished that it was possible to vary the erection procedure at will without any sacrifice in efficiency. After two of these anchor spans had been erected the suspended span between them was filled in a similar manner. Two locomotive cranes, one for each traveler, kept the derricks supplied with steel.

In some cases falsework was moved forward to the next span without dismantling, although, because of the varying height of the structure, it was usually necessary to change the length of the falsework. This was possible since the legs had been specially designed with splices to provide a length corresponding to all locations.

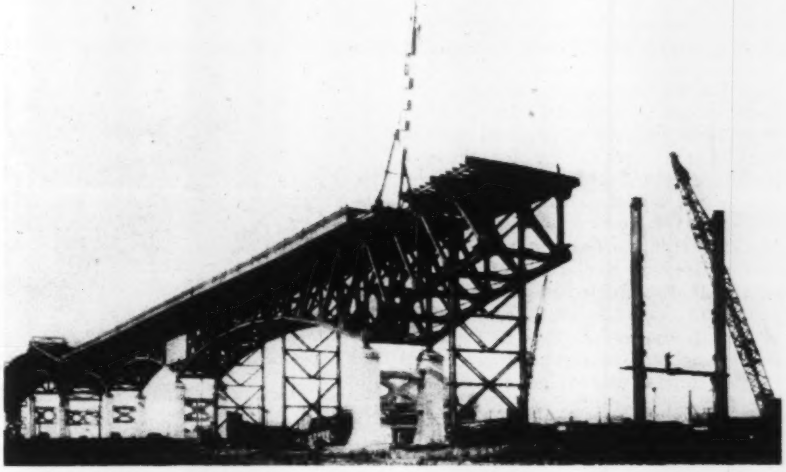
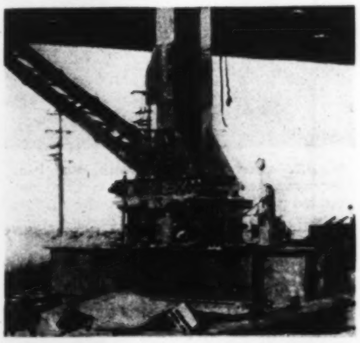


Fig. 10—Erection by deck traveler was the method adopted by McClintic-Marshall. Steel was brought in on a temporary track on the ground beneath the center line of the viaduct and lifted directly into place. Locomotive cranes set the falsework.

Fig. 8 — Steel falsework on McClintic-Marshall section was supported on both hydraulic and wedge jacks.



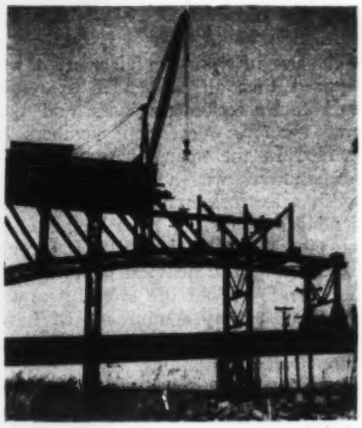


Fig. 9—Ramps introduced special difficulties. View is on McClintic-Marshall section where ramp required 148-ft.-span plate girders.

According to the contractor, the method of erection proved unusually efficient because of its great flexibility and because light falsework was possible inasmuch as the bridge did not have to carry any erection equipment. The relatively light load carried by the falsework also eliminated any difficulties with falsework settlement. Building the tracks for the travelers on the ground rather than on the structure made it possible to use common labor and to carry out the job more safely.

This contract involved about 17,500 tons of steel in which the heaviest piece handled weighed 55 tons and was erected by using both tower derricks.

General supervision of the field operations for the Phoenix Bridge Co. was in charge of J. F. Kinter, superintendent of erection. The scheme of erection was carried out under R. S. Foulds, engineer of erection. W. C. Bearce was foreman, and Frank W. Peirce was resident engineer.

McClintic-Marshall section

In the contract held by the McClintic-Marshall Corp. were included the two through cantilever bridges over the Hackensack and Passaic Rivers and nine deck-truss spans (of two-truss layout) connecting with the Passaic River bridge on the west and the Phoenix Bridge Co. section on the east. The length of the deck-truss section was about 2,500 ft., and the tonnage involved was 12,400. The longest span was 335 ft., and the maximum height above the ground 120 ft.

Deck-truss erection on this contract differed from the two previously described procedures in that a minimum of work was performed by ground equipment. Locomotive cranes set the falsework bents and the grillage pads and assisted in setting some 22-ton 148-ft.-span plate girders in a ramp (Fig. 9), but with these exceptions the erection was carried out by the A-frame deck traveler that previously had erected the west half of the Passaic River bridge.

Erection of the deck-truss spans proceeded from west to east. A temporary standard-gage track was laid on the ground the entire length of the work under the center line of the viaduct for material supply service. The traveler, picking steel directly from gondola cars, then erected everything complete as it advanced.

Steel falsework bents were used, consisting of H-section legs under each truss, braced apart by battened channel struts, with laced-channel X- and K-bracing in each panel. Steel grillages on mud sills supported the falsework legs, which were mounted on a system of hydraulic and wedge jacks for vertical adjustment (Fig. 8). Two falsework bents were used in each span, placed in general at the third points. Because of the weight of the deck traveler some of the joints between the cantilever and suspended spans had to be temporarily fixed, and in every span a temporary member was inserted in the third panel from the east end.

River Spans — The Passaic and Hackensack River crossings are duplicate bridges in design and were erected by identical methods. Each of the bridges involved 8,650 tons of steel. Each consists of a 550-ft. main span and 350-ft. anchor spans, 57 ft. wide center to center of trusses. Main-span clearance above mean high water is 135 ft. within the channel lines, while the highest steel placed was 210 ft. above mean high water. The Passaic River bridge was completed first. Its erection will be described, with only incidental reference to the Hackensack span.

Erection started on both the east and west anchor spans at about the same time. Steel was delivered on two temporary tracks directly under the spans. Locomotive cranes placed steel grillage pads for the four falsework bents under each anchor arm and drove 12-in. H-section piles where required (at one bent at the river's edge for the east anchor arm and at all four bents under the west anchor arm). As an initial operation, part of the steel falsework adjacent to the first pier was set and utilized as a platform for a guy derrick that assembled an A-frame traveler on top. This traveler operating on the deck of the anchor arm then removed the guy derrick and proceeded to erect steel to the center of the bridge where it met the traveler from the other side. A gasoline tractor erected the hand rail and top lateral system after the A-frame travelers had completed their work. For the main span the steel was delivered by car float and transferred directly into place in the bridge by the travelers.

On the Hackensack bridge (Fig. 11) the principal deviations from the above procedure were the use of steel H-section piles under all of the falsework bents and the erection of all steel direct from car floats. The steel H-section piles proved particularly adaptable to the conditions, for in some cases they had to be used in extremely long lengths, while in others practically no penetration was possible. In driving the piles, steel frames were used, acting initially as guides and later serving as permanent bracing for the piles. These frames were moved as units without dismantling them, as they were required for use under successive anchor arms.

For McClintic-Marshall the erection was under the direction of G. P. Bullard, manager of erection, with A. F. McLane as resident engineer and W. E. Omohundro and H. G. Reynolds as foremen.

Taylor-Fichter-section

Although the Taylor-Fichter Steel Construction Co. erected two sections, one at the extreme eastern end of the viaduct (under a subcontract with Charles T. Kavanagh, general contractor) and one (on its own contract) at the western end, only the latter involved the typical deck-truss construction. The east section comprised 6,000 tons of steel, largely plate-girder spans of 50 to 60 ft. in length, although there were also included four trusses of 120- to 220-ft. spans. Two of these were through spans over railroad tracks, and two were deck trusses over heavy traffic streets; the latter trusses adjoin on the east the through truss span erected by the American Bridge Co. This east section was erected by a 40-ft steam deck traveler with a 100-ft. boom, assisted by a crawler crane with a 45-ft. boom operating on the ground. Timber falsework was used except at the street crossings where steel was used instead.

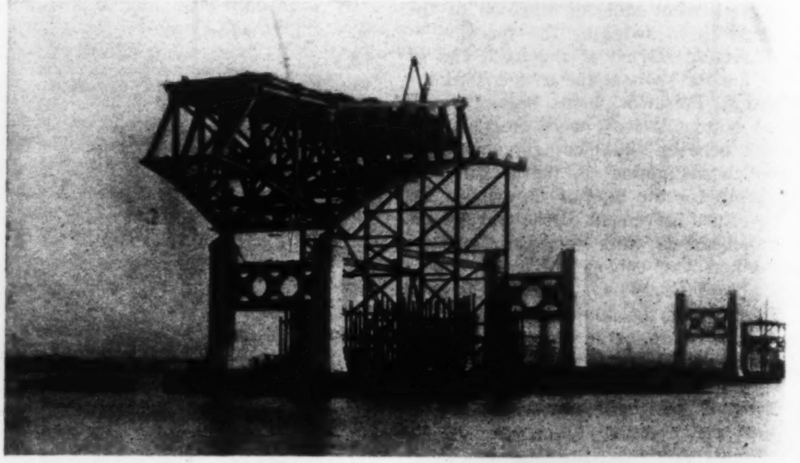


Fig. 11—Erecting west anchor arm of Hackensack River span. This bridge and the Passaic River crossing are duplicate structures.

The section at the west end of the viaduct included eleven deck-truss spans (two-truss layout), connecting at the east end with the Passaic River bridge. About 9,000 tons of steel was involved, which included a plate-girder ramp, providing an exit to the surface in Newark.

Erection of the deck-truss spans on this contract was carried out by deck travelers as on the McClintic-Marshall section, but with the important difference that gasoline crawler cranes with 90-ft. booms were used as supplementary equipment on the ground. These cranes, in addition to setting the falsework bents, also assisted in erecting the lower chords of the trusses. In contrast with the other contracts, no railroad track was laid on this section. Instead, temporary roads were built alongside the viaduct for use of trucks that delivered the steel and the crawler cranes that helped to erect it.

One 45-ton traveler with a 90-ft. boom started at the east end of the section, and another of the same capacity but with a 70-ft. boom and a narrower over-all width (since it was required also to erect the ramp later), started at the west end of the section. The two travelers met at the ramp intersection.

In contrast with all the other contracts on the viaduct, only one falsework bent was used per span on this section. This bent was located beneath the third panel point from the west end of the span unless special conditions made this impracticable. Each leg of a bent consisted of a structural steel angle tower about 10 ft. square, resting on a steel beam grillage and topped with steel beams upon which the trusses were supported on wedges and 200-ton hydraulic jacks. The legs were tied together transversely by wire-rope X-bracing. All falsework rested on wood piles. These towers, which were about 90 ft. high in the span adjacent to the Passaic River bridge, were designed to be reduced in length corresponding to the decreasing grade of the viaduct toward the west. In the last span the falsework was only about 30 ft. high.

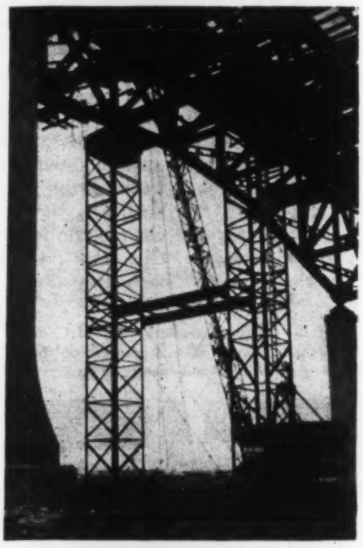


Fig. 12—Steel tower falsework, one bent per span, set by crawler cranes that also erected the lower members in the viaduct trusses, was used on the Taylor-Fichter section.

The use of a single falsework tower required that all suspended spans be fixed for erection purposes and that some temporary erection members be inserted in the spans. Against these disadvantages was a considerable saving in falsework expense over the use of additional bents. Also longer erection pieces (up to about 100 ft.) could be handled. The heaviest pick weighed about 42 tons. At the crossing of the Lincoln Highway a minimum of falsework was an advantage on account of dense traffic conditions.

For Taylor-Fichter the work was handled by J. Lowenstein, president and chief engineer. H. O. Adelman was designing engineer, Samuel Kapelsohn general manager, John Grandan foreman, and A. Krohn resident engineer.

Concrete Control Encouraged by Northwest Building Codes

Portland code permits higher stresses under controlled conditions, as has been done successfully for some years in Seattle

By H. M. Hadley

Regional Structural Engineer, Portland Cement Association, Seattle, Wash.

Adoption of a revised section of the building code for reinforced-concrete construction by Portland, Ore., establishing two classes of concrete work, with corresponding values of working stress, emphasizes this plan which has been in successful operation in Seattle for more than a decade. The purpose of the code provision is to allow safe working stresses for concrete mixed according to definite proportions with only nominal inspection and to encourage better concrete practice, whenever economically feasible, by raising the allowable working stresses for concrete mixed with careful control of the w/c ratio under continuous technical supervision.

It is generally customary for building codes to provide but one class of concrete, with one set of working stresses. These stresses, of necessity, must apply to work that may be improperly done as well as to that which is controlled and carefully executed; they must be average working stresses. As such, they really penalize and offer no encouragement to good work, while at the same time they may be unduly liberal with respect to poor and careless work. There is no way to avoid this situation with a single standard classification.

Seattle, Wash., was the first city to adopt two classes of concrete based essentially on control and supervision. The 1921 revision of its code followed closely the current Joint Committee recommendations, but it required the presence of a qualified concrete supervisor on all work employing the higher stresses, which were considerably above those previously allowed. Selection of the supervisor could be made by the architect from a list of those who had successfully passed an examination for the position given by the building department. This inspector was paid by the owner, reported daily to the building department and could be removed for cause by the department. Testing of all materials entering into the work was also required.

This type of concreting operations, including the services of a supervisor and the testing of materials, was not mandatory, however. If a job was small or, even in the case of a large job, if the owner preferred not to incur the expense of supervision and testing, he was free to proceed without what he might regard as unnecessary restrictions. For such work, however, section 427 of the Seattle code states, "The ultimate strength of concrete not under expert supervision shall be assumed as 75 per cent of that given in the above table." This requirement results, of course, in heavier concrete sections and increased reinforcement in lieu of the more careful control and supervision. It is decidedly to the owner's interest in any work of magnitude, not only with respect to first cost but also with respect to the quality of the finished building, to have the concrete work supervised and to take advantage of the higher working stresses. The city, concerned with public safety, likewise is assured of a better quality of work by this arrangement.

The successful experience in Seattle in more than ten years' use of this plan had its influence upon the new Portland code, section 208 of which states:

> . . . . . "Reinforced concrete may be designed, mixed and proportioned in either one of two systems: one where the cement, sand and coarse aggregate are mixed in definite proportions such as 1-2-4 or 1-3-5, etc., meaning one part of Portland cement, two parts of sand and four parts of gravel, etc.; or two, where the concrete mixing and placing is carefully supervised and with control of the ratio of the amount of water to the amount of cement used."

The usual requirements and safeguards regarding materials, mixing, placing, etc., are set forth. However, for concrete on the basis of "definite proportions" no special inspection requirements are established by the code.

WORKING STRESSES ALLOWED BY NEW CODE
(For concrete with ultimate strength of about 2,000 lb. per sq.in.)

	"Definite Proportions" Lb. Per Sq.In.	"Water-Cement Ratio Concrete and Control" Lb. Per Sq.In.
Steel		
Tension	16,000	18,000
Concrete		
Flexure—Compression	650	800
Flexure—Compression adjacent to support	750	900
Shear		
—plain concrete	40	40
—"punching"	120	..
—with web reinforcement and anchorage for longitudinal steel	...	180
Bond		
—plain bars	80	80
—deformed	100	100
Axial compression		
—plain rodded columns	450	450
—spiralled columns	...	$300\,(0.10 + 4p)f'_c$

For "water-cement ratio concrete and control," section 232 (*a*) recognizes two classes of this concrete: first, that which is based on established results with average materials customarily used in Portland; second, a class where special advance and preliminary tests are made on special mixes, and an increased amount of testing is done during the progress of the work. Both classes of this concrete require the continuous supervision of a qualified and experienced supervisor,

> . . . . . "who shall be paid by the owner and shall work under the direction of the Bureau of Buildings . . . . . the supervisor shall be a person thoroughly qualified by training and experience in the theory and construction of reinforced-concrete structures . . . . . (he shall) have direct control of all factors, other than the design, which affect the strength of the concrete of the structure.
>
> "It shall be unlawful for any person to place any concrete in a structure requiring supervision unless there be present a regularly appointed supervisor. . . . . It shall be unlawful for a contractor to carry on his work . . . . . contrary to the instructions of the supervisor If the contractor fails to carry on his work in a proper manner, the supervisor shall order the work stopped."

The table compares the principal permitted working stresses in sections 216 and 236 of the new Portland code for a 1:6 mix on the "definite proportions" basis without special supervision and for a 7½-gal. w/c concrete with supervision. These mixes may both be assumed to produce about 2,000-lb. concrete.

For a "definite proportions" concrete with a mix of 1:3 the working stresses are permitted to be increased 20 per cent, e.g., the 650 compressive stress would be increased to 780 lb. For a 6-gal. "w/c ratio concrete," controlled and supervised, with approximate proportions of 1:4 and a strength of about 3,000 lb., the stresses given in the table would be increased 50 per cent, e.g., the 800-lb. compressive stress would be increased to 1,200 lb.

This evaluation of concrete construction on the basis of control and supervision exercised is fundamentally sound and in accordance with the principle that higher working stresses should be allowed on work that is carefully done. It provides encouragement and incentive for that kind of work. On the other hand, it is equally proper that work not as carefully controlled should be safeguarded by appropriately lower stresses and an increase in the quantities of materials. Just as inspection and grading marks establish degrees of quality in lumber, or as label service assures quality in insurance ratings, so does proper and adequate field inspection of concrete furnish a warranted basis for increased and higher working stresses.

New Water Supply Serves Pennsylvania Coal Towns

Panther Valley Water Co. builds rolled-fill dam on tributary of Little Schuylkill to impound 600 m.g.—Welded steel line 10 miles long laid over rugged country

A NEW water supply, having a capacity of 10 m.g.d., part of which is to be used for washing coal, is nearing completion in the anthracite region of eastern Pennsylvania. The supply is to be impounded by a rolled-fill dam on Still Creek and conveyed through a 30½-in. welded steel pipe line 10 miles long to the distribution systems, operated by the Panther Valley Water Co., which serves several coal-mining towns and a number of collieries lying in the Panther Creek Valley, east of Tamaqua in the southern part of the anthracite region. Still Creek is a tributary of the Little Schuylkill River, into which Panther Creek also flows at a lower point. The line chosen for the pipe line was, in general, down the valley of Still Creek to the Schuylkill, down the Schuylkill River to Panther Creek and up the valley of that stream.

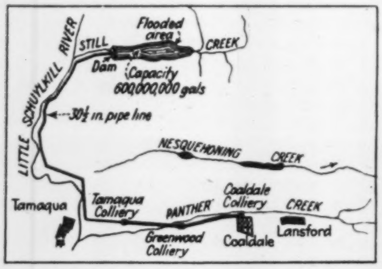


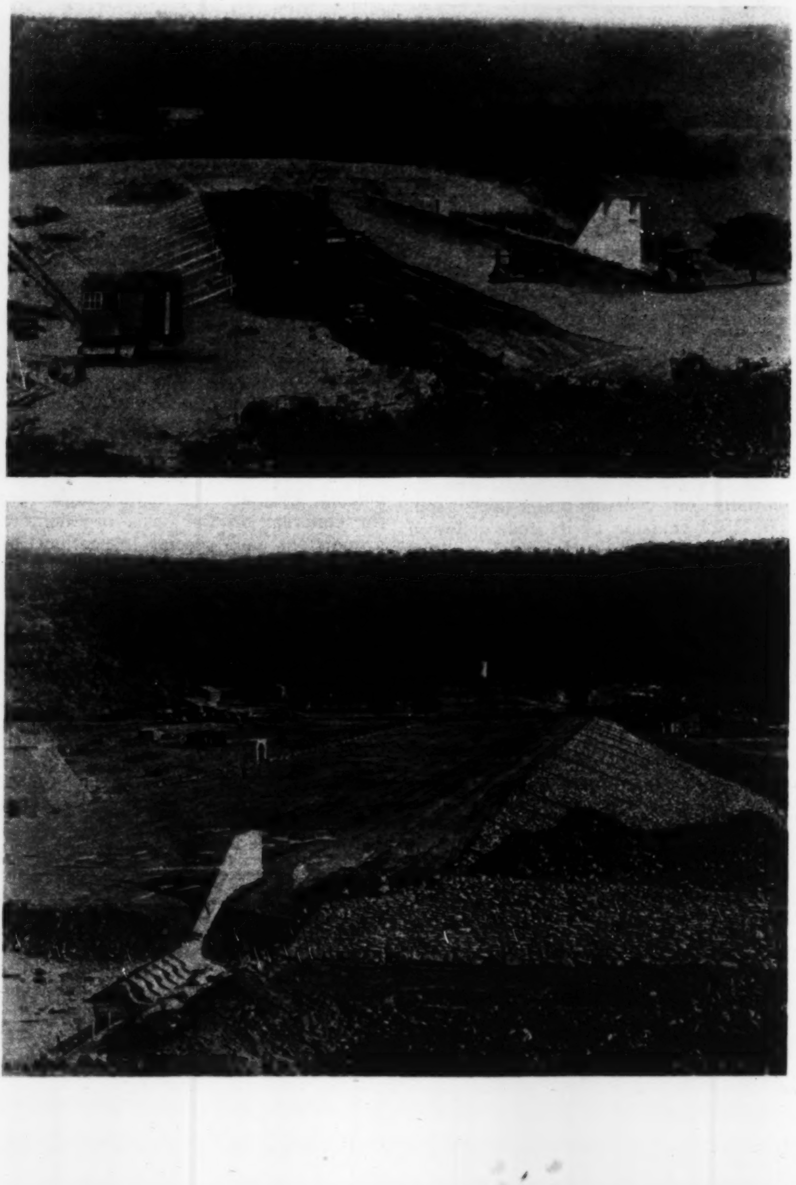
Fig. 1—New water-supply system in Pennsylvania anthracite regions includes a 600-m.g. reservoir formed by a rolled-fill dam and a gravity supply line that traverses three river valleys in reaching its distribution points.

Part of the demand necessitating the new supply results from the plans now made for washing coal with fresh water at the various collieries of the Lehigh Coal & Navigation Co., which owns the Panther Valley Water Co. The idea of washing coal with pure clean water is somewhat of a novelty in the anthracite region and will do two things. It will reduce the rate of deterioration of pipe lines, pumps and equipment at the collieries and produce a coal clean and free from acid. Heretofore, coal has been washed largely by acid-bearing water drawn from the mines or by re-using water until it became black and highly acid. The new water supply will be delivered by gravity, eliminating numerous pumping installations. As a result of this plan there will be a saving in the actual cost of operating the collieries because of the reduced pumping, there will be a saving in depreciation, repairs and maintenance of the colliery equipment, and it will increase the saleability of coal due to the improved quality resulting from thorough washing.

The dam on Still Creek is an earth structure with a concrete cutoff wall extending up into it about 10 ft. The cutoff wall itself was built about four years ago. The new construction carries the cutoff wall to 20 ft. above the streambed in the center of the channel and to the full height of the dam at the spillway. The spillway is located at the north end of the dam, is lined with rock and provided with a concrete ogee. The dam has been constructed to a height of 60 ft. above the streambed at present, enabling it to impound 600 m.g. of water. It is planned to raise it 30 ft. some time in the future, which will increase the storage capacity to 2,500 m.g.

The borrowpits from which the fill material was obtained were located largely within the reservoir area. The material is about 50 per cent clay and was easily consolidated by the use of 12- and 8-ton rollers. It had originally been intended to use impervious material only for a corewall of one-third the thickness of the dam, but the good material was so easily available that the dam was constructed by using this material for all except the downstream

Fig. 2—Two views of the dam during its construction, one taken from each end. The ogee crest for the spillway and the end of the cutoff wall can be seen in the lower view.



third of its thickness. The upstream face is lined with 3 ft. of riprap, and the downstream face is paved with the same material.

At the toe of the dam a concrete intake tower has been built 60 ft. high. It is strongly buttressed to withstand ice pressure. From the intake tower two 36-in. cast-iron pipes, each controlled by a hand-operated gate valve, lead through the face of the dam to the gatehouse built in the old stream valley just below the dam. The pipes through the dam are protected by a heavy concrete box.

A 30½-in. welded steel pipe line extends from the gatehouse to the water-distribution systems of Tamaqua and several towns supplied by the Panther Valley Water Co. The pipe is of ⅜-in. steel plate with a $\frac{3}{32}$-in. bitumastic enamel lining that is spun in place. The pipe is made with a single longitudinal shop-weld. The results of shop tests have shown that the plates have an ultimate strength of 50,000 to more than 60,000 lb. per sq.in. All pipes are tested in the shop for a hydrostatic pressure of 275 lb. per sq.in. They are made in 30-ft. lengths and are given a spray coat of primer.

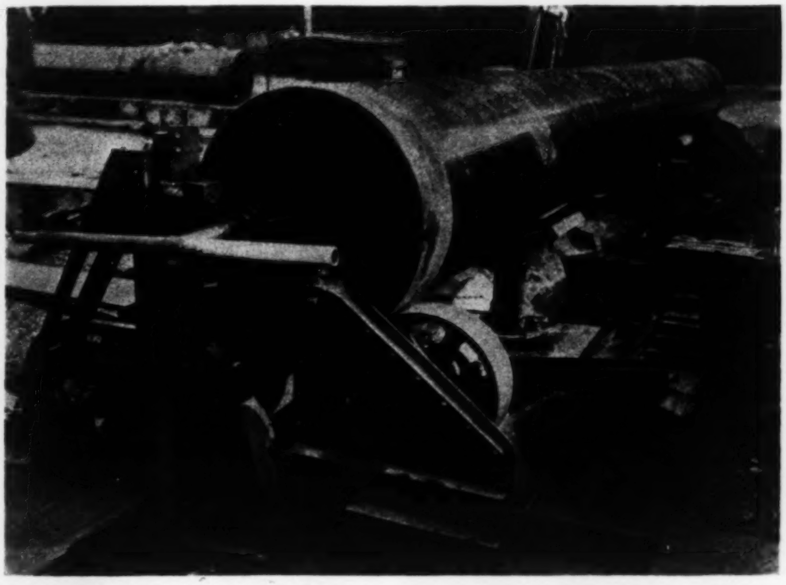


Fig. 4—The pipe is given a bituminous lining, which is spun in place as the pipe, resting on two power-driven rollers at each end, is rotated at 200 r.p.m.

At Tamaqua, in the railroad yard of the Lehigh and New England Railroad, a plant has been set up for lining the pipe. As soon as the pipe is unloaded from the cars bringing it from the mill, it is inspected, and any roughness in the longitudinal weld are removed. After it has been given a second priming coat, a hand-brushed coat of enamel is then applied to the longitudinal weld to assure an adequate thickness of lining at that point after the spinning operation has been completed.

Two driven rollers at each end support the pipe during the spinning process. The melted lining material is run into a long trough that passes through the pipe and is supported by a trunnion at each end. When the pipe has attained a rotating speed of 200 r.p.m., the trough is tilted, allowing the enamel to spill onto the interior surface of the pipe and be spread out to an even thickness by the centrifugal force. To cool the pipe and speed the setting of the lining material, a stream of water is played on its outside surface. At each end of the pipe 6 in. is allowed to remain free of lining to facilitate the welding of the girth joint.

At the side of the trench three and sometimes four lengths of the pipe are butt-welded together to give 90- or 120-ft. lengths. Gasoline-engine-driven generators supply the current for welding. Bolted sleeve couplings are used to join the sections of the pipe together and at each fitting. After the couplings have been made up, all the joints are coated with a hand-brushed coat of enamel on the inside, and the pipe is thoroughly inspected and repainted where abrasions of the outside or inside coatings have occurred in handling.

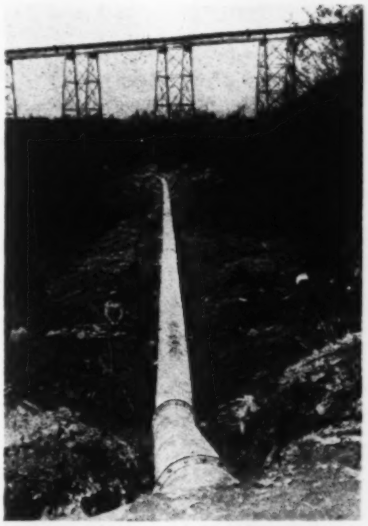
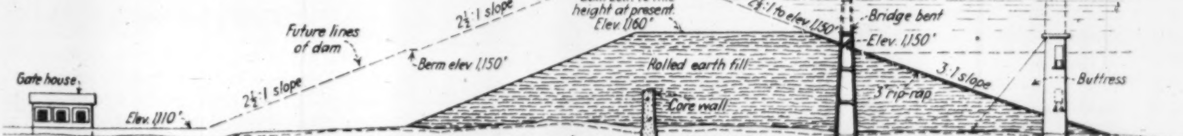


Fig. 5—For much of its length the line follows rough country. Pipe lengths are butt-welded together to give 90- or 120-ft. sections. The sections are joined by bolted sleeve couplings.

As soon as possible after the pipe is laid, it is backfilled, except at the couplings. It is then tested in lengths of about 5,000 ft. at a pressure of 100 lb. per sq.in. with water drawn from the reservoir. After the joints have been inspected and any leakage corrected, the backfill is completed. The pipe so far, as tested, is practically watertight.

Over much of its route the pipe line follows rough country, with only about a half mile in open farming land. In the valley of the Schuylkill River it follows a rocky hillside covered with second-growth timber and has to cross the valleys of several small streams entering the river. For another half mile the line runs in a narrow strip between a concrete highway and the Schuylkill River, where part of it must be supported on cradles and protected by masonry walls. Other sections of the pipe run through culm banks, where

Fig. 3—Dam on Still Creek is built with a view to a future raise of 30 ft., which will increase the reservoir capacity to 2,500 m.g.



the excavation is made wide and deep and the backfill around the pipe is made with clay. At several such points the outside of the pipe is protected with a heavy coating of bitumastic enamel since acid water and culm might cause corrosion.

The pipe is held in place at numerous points by heavy concrete anchors at sharp angles in horizontal and vertical alignment. The necessary air valves and blow-off valves are installed, also several large shut-off valves to isolate certain sections in case of trouble.

Gannett, Seelye & Fleming are the designing engineers and the general contractors for the dam and pipe line. McClintic-Marshall Company has the subcontract for furnishing and laying the pipe, the shop inspection being done by the Robert W. Hunt Co. Frank H. Eastman is in direct charge of the construction, and J. Donald Carpenter is in charge of field engineering.

Batching Plant Economics for Separate Aggregates

Analysis and comparison of plant arrangements for one, two and three sizes of aggregates—Formula for determining extra trucks—Bulk cement decreases cost

By T. C. Thee and O. K. Normann

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THE USE of coarse aggregate in two or three separate sizes for portland cement concrete paving is now required in several states. Thus, for example, Wisconsin requires the coarse aggregate to be separated into two sizes when the maximum size is 1½ in. and into three sizes when the maximum size is 2½ in. This separation of sizes is intended to eliminate as much as possible such segregation as may take place in car delivery and in stock piling, and thus secure a more uniform gradation of the coarse aggregates and help to reduce the batch-to-batch variations.

An analysis of the operation of many batching plants handling multiple and single sizes of coarse aggregates leads to the conclusions: (1) that one two-compartment bin should be used where only one size of coarse aggregate is required; (2) that one three-compartment bin should be used where two sizes of coarse aggregate are required; and (3) that two two-compartment bins should be used where three sizes of coarse aggregates are required.

Plant requirements

Whenever the proper plant layout can be secured, only one crane will be necessary to supply the bins for a 27E paver, using either one, two or three sizes of coarse aggregate. The area of the batching plant site, however, must of necessity be larger than that for handling multiple sizes of coarse aggregate in order to provide room for the extra stock piles, even though this space be kept at a minimum by the use of planking. The cost of handling multiple sizes of coarse aggregate at the batching plant should therefore be limited to the cost of the larger or additional bin and its operator's wages. The cost of the bin for one size of coarse aggregate and the sand is about $2,000. The cost of a three-compartment bin to handle two sizes of coarse aggregate and the sand is about $2,900. For three sizes of coarse aggregate and sand, two two-compartment bins will cost approximately $4,000.

The number of trucks required to handle the multiple sizes will have to be increased, of course, as the amount of time spent at the batching plant increases. The following simple equation is given to compute the number of trucks that will have to be added as the amount of time spent at the batching plan increases:

Let T' = the additional time in minutes that each truck is required to spend at the batching plant.
t = the mixer cycle in minutes.
n = the number of batches per truck.
N = the number of extra trucks required due to the additional time spent at the batching plant.

$$\text{Then } N = \frac{T'}{nt}$$

If the mixer cycle is 73 sec., then according to this formula 0.82 one-batch truck, 0.41 two-batch truck, or 0.272 three-batch truck will have to be added to supply the mixer with materials for maximum production for every additional minute spent at the batching plant by each truck. According to this formula one full truck has to be added when the time spent at the plant is lengthened by the product of the mixer cycle times the number of batches carried per truck. Thus, for a mixer cycle of 73 sec., one additional truck has to be added when the time spent at the loading plant is increased 73, 146 and 219 sec. for one-batch, two-batch and three-batch trucks, respectively.

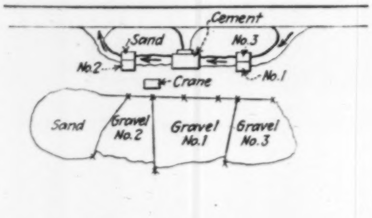


Fig. 1—Batching-plant layouts for handling one, two and three sizes of coarse aggregate when aggregates are hauled in by truck or batching plant is set up at a local producing plant.

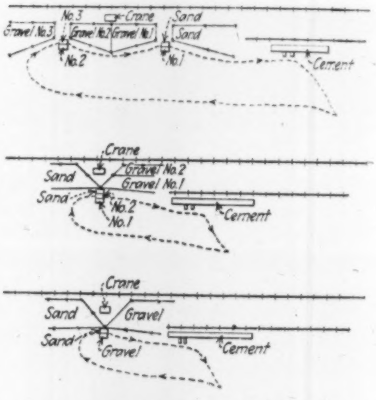


Fig. 2—Batching plant layouts for handling one, two and three sizes of coarse aggregate when aggregates are hauled in by railroad.

Turning and backing a truck under a bin requires from 20 to 30 sec. Good management, therefore, requires that the batching plant be so planned and laid out that the trucks can drive through the bin or bins without turning or backing. This will save about 20 to 30 sec. for a one-bin layout and from 40 to 60 sec. when a two-bin layout is required.

Field plant studies

During the past three seasons detailed studies have been made of a number of batching plants in which special attention was given to the effect on operating efficiency of such features as yard layout and methods of operation.

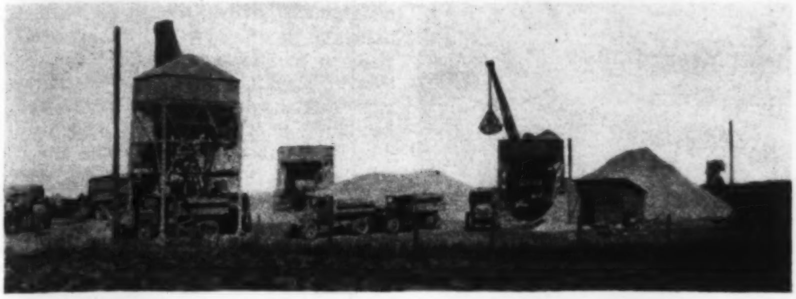


Fig. 3—This batching-plant layout required the trucks to back and turn under the two aggregate bins to load the three sizes of coarse aggregate and the sand. The bins could have been placed so that the trucks could drive straight through, and in general the plant layout could be confined within a smaller area. See Fig. 5.

These studies include plants located at railroad sidings, plants located at local producing plants and plants located so that all materials were brought in by truck haul. Most of the jobs also used bulk cement, which the batch trucks generally carried either on top of each batch, lightly covered by sand or aggregate, or else where two aggregate bins were used, dumped between the aggregates from the first and second bin. This latter method proved very fast, efficient and satisfactory.

As a result of the data and experience secured during these studies, two general types of batching-plant layouts are recommended for use in connection with one, two and three sizes of coarse aggregates. These are shown in general outline in Figs. 1 and 2. The type of layout shown in Fig. 1 is adapted to locations where all the materials are brought to the plant by truck haul or when the batcher set-up is at a local producing plant, while the type of layout shown in Fig. 2 is more especially adapted to locations at railroad sidings.

Plant analyses

Tables I and II show the average operating characteristics for two-batch trucks for each of the layouts represented in Figs. 1 and 2, respectively. It is interesting to note in Table I that when the bulk cement is handled as there indicated, then the time which each truck of any given size will require to pass through the yard will be approximately the same regardless of whether the job uses one, two or three sizes of coarse aggregate. The reason for this is that the additional time required to cover the cement when one or two sizes of coarse aggregate are used is practically the same as the time requird to load from the second bin when three sizes of aggregate are used. Therefore, where all the materials are hauled in by truck the cost of the one item of batching, if handled as shown in Fig. 1, will be nearly the same whether one, two or three sizes of coarse aggregate are used. The only increase in the batching plant itself is the employment of one additional bin operator and the use of an additional bin when three sizes of coarse aggregate are required.

Table II summarizes the average operating characteristics of two-batch trucks when loaded from a batching plant of the type shown in Fig. 2. The two sizes of coarse aggregate are handled with practically the same ease and speed as one size, the difference in loading being only 5 sec. There is, however, a difference of 54.6 sec. between the batching-plant truck time constants when handling one or three sizes of coarse aggregate. This longer time constant may readily require the constant use of one extra truck to absorb this time, which, if two-batch trucks are used exclusively, may amount to practically $25 a day. Considering one extra operator for the added bin and the cost of the extra bin, the added cost for the three sizes of coarse aggregate is about $35 a day.

One crane can load the bins for three sizes of coarse aggregate for a batching-plant layout such as shown in Fig. 1. However, if all the aggregate must be passed through the stock pile for the type of batching plant shown in Fig. 2, then two cranes will be required. Therefore, the additional cost of handling three sizes of coarse aggregate with the plant layout shown in Fig. 2 may be as much as $85 a day more than for the layout shown in Fig. 1.

Furthermore, when three sizes of

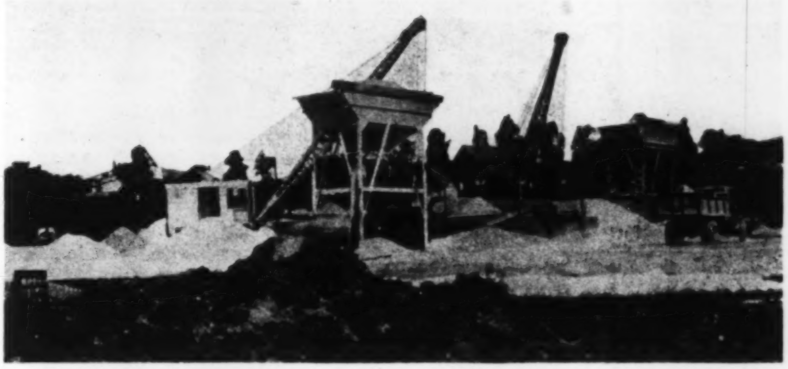


Fig. 4—Trucks operating out of this plant had to back and turn under each aggregate bin to load the three sizes of coarse aggregate and the sand and then travel 1000 ft. more to be loaded with cement. In addition, the plant covered so large an area that two cranes had to be used. It cost this contractor about $100 more per day than if he had set up his plant as shown in Fig. 5.

TABLE I — AVERAGE BATCHING-PLANT CHARACTERISTICS FOR TWO-BATCH TRUCKS IN PLANT LAYOUT SHOWN IN FIG. 1

Three Sizes	Seconds	Two Sizes	Seconds	One Size	Seconds
Load gravel Nos. 1 and 3	34.6	Load gravel Nos. 1 and 2 and sand	45.0	Load gravel and sand	40.1
Load cement	54.0	Load cement	54.0	Load cement	54.0
Load sand and grave No. 2	33.0				
	121.6		99.0		94.0
Drive in yard	11.1	Drive in yard	11.1	Drive in yard	11.1
Drive from hopper No. 1 to cement bin	7.6	Drive from hopper No. 1 to cement bin	7.6	Drive from hopper No. 1 to cement bin	7.6
Drive from cement bin to hopper No. 2	6.8				
	25.5		18.7		18.7
Fix batch board	39.2	Fix batch board	39.2	Fix batch board	39.2
		Cover cement	25.0	Cover cement	25.0
	186.3		181.9		176.9

TABLE II — AVERAGE BATCHING-PLANT CHARACTERISTICS FOR TWO-BATCH TRUCKS OPERATING IN PLANT LAYOUT SHOWN IN FIG. 2

Three Sizes	Seconds	Two Sizes	Seconds	One Size	Seconds
Load gravel Nos. 1 and 3	34.6	Load gravel Nos. 1 and 2 and sand	45.0	Load gravel and sand	40.0
Load sand and gravel No. 2	33.0				
Load cement	54.0	Load cement	54.0	Load cement	54.0
Cover cement	25.0	Cover cement	25.0	Cover cement	25.0
	146.6		124.0		119.0
Drive in yard	60.0	Drive in yard	40.0	Drive in yard	40.0
Drive from hopper No. 1 to hopper No. 2	7.0	Drive from hopper No. 1 to cement	14.0	Drive from hopper to cement	14.0
Drive from hopper No. 2 to cement	14.0				
	81.0		54.0		54.0
Fix batch board	39.2	Fix batch board	39.2	Fix batch board	39.2
	266.8		217.2		212.2

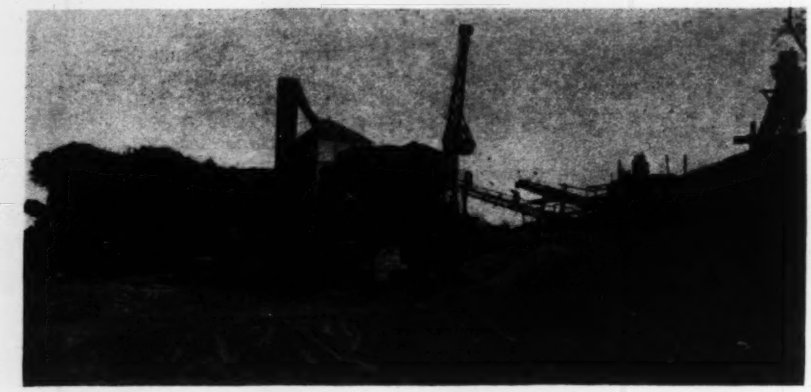
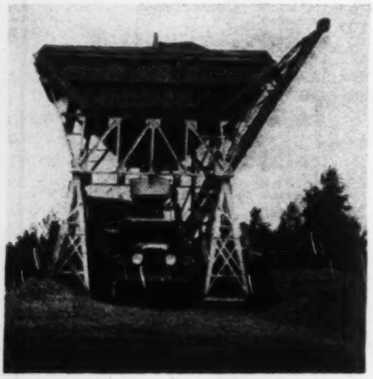


Fig. 5—This batching plant set-up for handling locally produced aggregates, with the coarse aggregate separated into three sizes, and for loading the sand and the bulk cement is the result of careful planning and supervision. Note the concrete foundations for the bins, as well as the fact that the clearance for the trucks is obtained by these foundations rather than by excavation under the bins, all of which pays a very high dividend for the investment.

coarse aggregate are handled at a railroad siding, greater facilities for switching, which are sometimes extremely difficult to obtain, have to be provided as well as a larger plant site. To secure delivery of all sizes at the proper rate and in the proper order is even more difficult. The chances for delay are therefore considerably increased, and this naturally tends to increase still further the cost of batching three sizes of coarse aggregate from a railroad-siding layout. If, in addition, the bins are so placed that the trucks have to turn and back under each bin, then the truck-time constant at the batching plant will be further increased from 30 to 40 sec. It is these latter unknown hazards that weigh heavily against the use of three separate sizes of coarse aggregate when the batching must be done at an ordinary railroad siding.

From the standpoint of batcher operations there is but little objection to the use of two sizes of coarse aggregate if three-compartment bins are available. The real difficulties come in finding room for three instead of two stock piles, and in getting cars spotted correctly, as well as having each shipment carry the proper amounts of each size and the proper gradation. These difficulties, however, are much less for two than for three sizes of coarse aggregate.

Fig. 6—This contractor handled the two sizes of coarse aggregate with this bin and the bin shown in Fig. 7. A three-compartment bin set-up for the trucks to drive through would have saved this contractor at least $35 per day.



Care should be exercised to have the batching plant roadway well drained and maintained. The driveway under the bins should not be depressed, especially if the soil is bad, because this may prove a prolific source of delay. Instead the bins should be raised on concrete foundations to give headroom for the trucks. This not only eliminates the necessity for depressing the roadway under the bins but also provides a safeguard against bin settlement. Any bin or set ot bins should have capacity for at least one hour's run of the mixer. All bins should be arranged so that the trucks can drive straight through the bin or bins without turning or backing. The coarse-aggregate sizes and the sand should each be confined by planking to reduce the stock-pile area as well as to keep the plant-site area at a minimum for the efficient operation of the trucks and the crane. These sources of delay are mentioned only briefly, yet are of sufficient importance to warrant the exercise of great care in order to eliminate a source of possible delays to the mixer. A combination of delays such as may be caused by empty bins, truck speed reduction, due to rough and poorly drained roadway within the plant, etc., may add an additional minute, on an average for a day or more, to the truck-time constant, which if not absorbed by the addition of another truck will probably reduce the mixer production about 4 per cent.

Cost conclusions

The studies indicate rather clearly that the direct cost of handling two sizes of coarse aggregate need not be greater than the cost of handling one size of coarse aggregate, provided a three-compartment bin is used, a well-planned layout is made and good supervision is maintained. Where the materials are hauled in by truck or the batching plant is set up at a local producing plant, the cost of handling three sizes of coarse aggregate should not exceed the cost of handling one or two sizes by more than 2 or 3c. per batch, provided the layout suggested in Fig. 1 is used and the operation is properly supervised.

When the bulk cement cannot be loaded between the aggregates or when sack cement must be used or is required, the cost of handling three sizes of coarse aggregates will be about $35 a day more than the cost of handling one or two sizes of coarse aggregate, even when using a straight-line loading plant layout.

When the aggregates are handled at the railroad siding and have to be stock-piled first, then this added cost will be increased to $85 a day, using the same straight-line loading plant layout.

Finally, careful planning of the plant location and layout, when supplemented by constant and able supervision, can insure a substantial saving in the cost of truck operation regardless of whether or not multiple sizes of coarse aggregate are required and can reduce the risk of mixer delays due to batching operations.

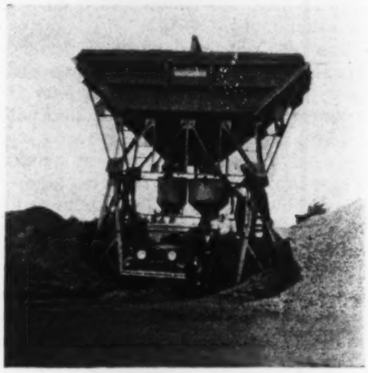


Fig. 7—The large coarse aggregate was loaded from the bin shown in Fig. 6, and the sand and small coarse aggregate were loaded from this bin. Turning and backing causes congestion and delays to the trucks; a three-compartment bin set-up, so that the trucks could drive straight through, would save at least $35 a day as well as a number of delays caused by such a plant layout as this one.

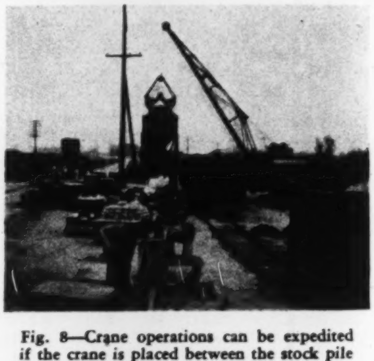


Fig. 8—Crane operations can be expedited if the crane is placed between the stock pile and the railroad cars instead of between the bin and the railroad cars.

Cement-Asbestos Pipe Used for Water Line

Winnipeg makes trial installation where soil is highly corrosive — Special sleeve joints used

PIPE composed of asbestos fiber and portland cement has been used for a new water line between Winnipeg, Man., and the adjacent suburb of Tuxedo. The soil in Winnipeg is of a highly corrosive nature, and as pipe made of this material is reputed to be highly resistant to such conditions it was decided to give the material a trial.

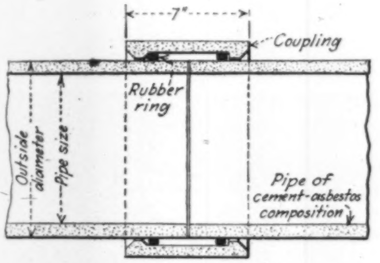


Fig. 1—The pipe sections were joined by the use of special composition sleeves made watertight by rubber rings.

Metal pipe laid in Winnipeg has suffered from both corrosion and electrolysis, but tuberculation is practically unknown. The Winnipeg soil is a lacustrine and alluvial silt underlying glacial till and is rich in lime. The soil had its origin in the grinding and pulverizing of limestone rock areas lying immediately to the north and has been formed by the southward moving glaciers of the ice age. The soluble salts originally present in the limestone have been crystallized and can be observed in pockets and stringers both vertical and horizontal in the clay immediately underlying the surface soil. Consequently when a trench for a water main is dug, salt deposits are usually encountered at some point, and in the backfilling of the trench are brought into contact with the water main.

The groundwater and leakage from the main dissolve the salts, and the solution acts as an electrolyte in conjunction with dissimilarities in the composition of the metal composing the main, permitting corrosion to take place. If the action of stray currents from an electric railway system is superimposed on mains already exposed to corrosive soils, the destruction may be quite rapid. The complete protection of buried pipe from the action of both corrosive soil and stray-current electrolysis by impermeable coatings is of course possible, but the cost of such protection is a consideration. Again, if the coating is abraded or broken at any point, it leads to a concentration of action where the metal is exposed, with an extremely rapid destruction of the pipe at that point.

To provide an auxiliary feeder and to improve pressure in the southwestern part of Winnipeg and in Tuxedo, a residential suburb lying to the southwest of Winnipeg, an 18-in. feeder line was laid from Portage Ave. along St. James St., crossing the Assiniboine River and thence along Kenaston Boulevard. Two years ago an 18-in. cast-iron main was laid beneath the river, but it was not connected up with the system. In the spring of 1932 it was decided to complete this connection, and bids were asked for. The bid of the company proposing to supply cement-asbestos pipe was the lowest of those submitted, and it was decided to give the material a trial.

The pipe is composed of asbestos fiber and portland cement combined under pressure to give, according to the manufacturer, a dense homogeneous structure with high strength and unusual resistance to destructive agencies. The pipe has been in use in Italy for a considerable number of years and is now being manufactured in America by the Johns-Manville Corp. under the trade name "Transite." The material weighs 125 lb. per cu.ft.

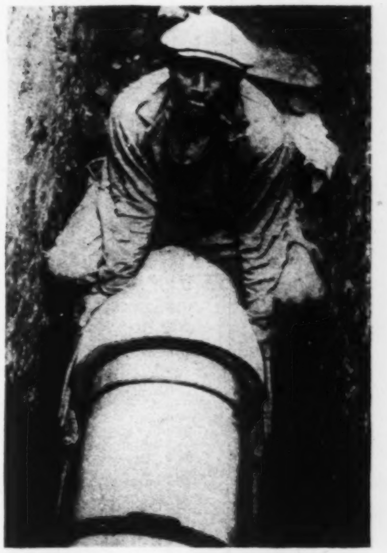


Fig. 3—When full lengths were to be joined in the trench the composition sleeve was pulled into place by drawing up on the rods shown, which pull against a steel plate across the end of the pipe section being laid.

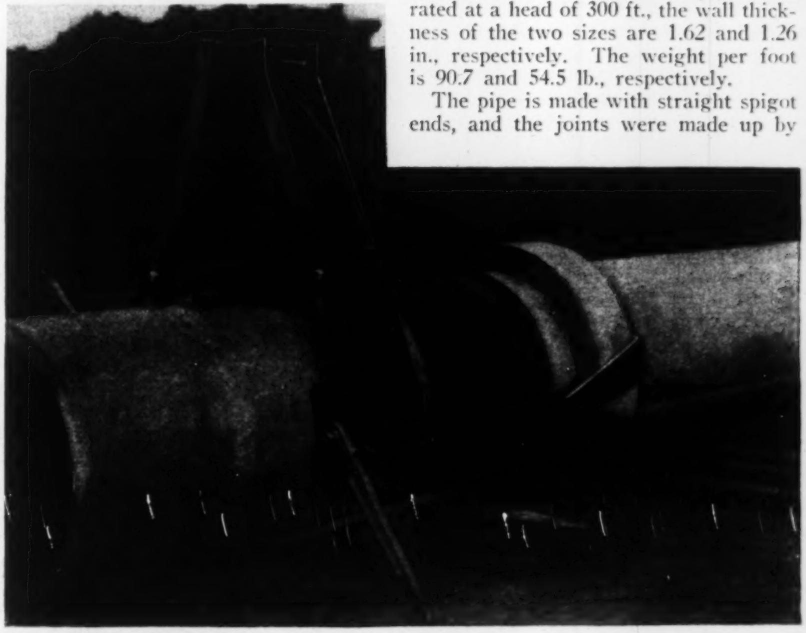


Fig. 2—The sleeves were pulled into place, the rubber rings compressing and rolling into position.

The pipe is manufactured in seven different classes, providing for heads as high as 500 ft. The manufacturer claims that the pipe is highly resistant to external and internal corrosion, tuberculation, electrolysis and many chemical reactions, and that it has a higher delivery capacity than new and clean metal pipe of the same diameter and under the same conditions of head and installation.

In the Winnipeg installation 814 ft. of 18-in. pipe and 442 ft. of 14-in. pipe were laid. In the class of pipe used, rated at a head of 300 ft., the wall thickness of the two sizes are 1.62 and 1.26 in., respectively. The weight per foot is 90.7 and 54.5 lb., respectively.

The pipe is made with straight spigot ends, and the joints were made up by couplings consisting of sleeves made of the same material and rubber rings. The apparatus used to couple two lengths of pipe together is shown in Fig. 2. In constructing the line the sleeve was placed over the end of the length of pipe to be laid, and one rubber ring was placed over the same end a distance equal to the length of the sleeve back from the end of the pipe. The other rubber ring was placed at the end of the same pipe. It was found that extreme care had to be taken to see that the horizontal axes of the two lengths lay in the same line or the rings would not roll properly into position. The claws of the coupling rig were placed over the sleeve, and the clamp was secured tightly to the sides of the fixed length of pipe. When pull was applied to the claws the sleeve was drawn toward the joint, the rubber rings rolling under the beveled edge of the sleeve and compressing as they reached their final position. By removing the claws and reversing the procedure the couplings could be pushed into place instead of being pulled. This method was required in laying the last section of the line.

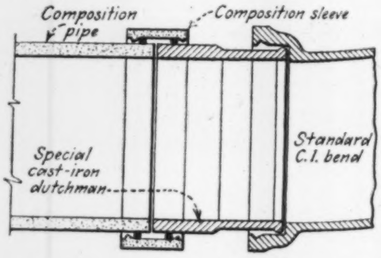


Fig. 4—When the composition pipe was to be connected to cast-iron fittings or valves, a special cast-iron dutchman was used to make the transition.

A modification of the jointing apparatus was used when joining full lengths of pipe. Instead of the A-frame a 1-in. plate, 3 in. wide, was placed over the end of the free section, the sleeve and rubber ring being placed over the length already laid. Full-length rods, 15 ft. long and 1 in. in diameter, threaded at the end, were passed through holes drilled in the plate. Claws were fastened to the free end of the rods and engaged the sleeve. When a turnscrew on the plate end of the rod was operated, the coupling was pulled into place. Special cast-iron dutchmen were used to connect the composition pipe to bends, gate valves and other cast-iron fittings.

The labor cost of laying and jointing this pipe was found to be higher than is usual for cast-iron pipe in this vicinity. The men, however, were not familiar with this type of joint, and it is thought that if more of the pipe is laid in the future, the cost can be substantially reduced. One disadvantage lies in the size of the bell holes required and the extra width of the trench that is necessary because of the jointing equipment. Little difficulty was encountered in familiarizing the laborers with the use of this type of pipe.

After the laying had been completed a hydrostatic test of 150 lb. per sq.in. was applied. This is double the pressure that the pipe would be normally subjected to, and no leakage was observed.

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Rapid Progress Being Made on Vancouver Water Tunnel

DRIVEN and half lined, the tunnel under the First Narrows at the entrance of the harbor at Vancouver, B. C., being built by the Greater Vancouver Water District, is scheduled for completion by June, 1933, after a rapid period of construction. This pressure tunnel will replace the present system of submerged mains, bringing the district's water supply from sources north of the city. Two shafts, 400 ft. deep and 3,104 ft., of $7\frac{1}{2}$-ft.-diameter tunnel, are the principal features of the development, which will connect with existing facilities at either end. Capacity of the tunnel is designed for the ultimate supply from Capilano Creek of 200 m.g.d. (Imperial).

The water supply for Vancouver is obtained from two mountain streams, Capilano Creek and Seymour River, north and across the harbor from the city. Since the completion of the original water-supply system in 1880, water has been taken across the inlet at either of the two narrows in submerged cast-iron pipe lines. The method of laying one of these submerged lines is described in detail in *Engineering News-Record*, Sept. 2, 1926, p. 366. The supply from Capilano Creek is piped under the First Narrows, which is the main harbor entrance. During 1931 the port of Vancouver handled a greater tonnage of shipping than any other harbor in Canada, and the occasional breaking of the mains near the shore connections by the grounding of ships and other problems involved in maintaining this part of the water-supply system made the continuance of this submerged crossing no longer justifiable for a large and rapidly growing city.

With the formation of the Greater Vancouver Water District in 1926, investigations were immediately undertaken to find a suitable location for a pressure tunnel under the narrows. The south or city end of the proposed crossing was fairly definitely established by the location of the line into the city and could not be changed more than a few hundred feet. Rock underlining the narrows was found to consist of sandstone and shale for the south half of the channel width, with the northern half overlain with a glacial deposit of boulders and gravel varying from zero depth at mid-channel to about 300 ft. one-half mile to the north. Conditions for the tunnel location had to satisfy navigation requirements, which included a proposal for future widening by dredging of the glacial deposits and the finding of solid foundation for the landing and sealing of a caisson which would permit the north shaft to be sunk to the proposed tunnel level. The investigations disclosed a small area of solid foundation at the north end about 110 ft. below high-water level in a position suitable for both the shaft and tunnel terminal.

The south shaft was sunk through boulder clay hardpan for a depth of 65 ft., and the remainder of its 400-ft. depth was in sandstone. The north shaft was sunk through sand and gravel for the 110-ft. depth to rock and then in sandstone and shale. The tunnel was driven in sandstone, conglomerate and shale, and was timbered only in the shale formation for a length of about 1,100 ft.

The upper 160 ft. of shafts will be lined with $1\frac{1}{8}$ in. of steel plates and an inner concrete lining 4 in. thick. The remaining depth of shafts and the tunnel are being lined with steel-cylinder, reinforced-concrete pipe to provide for strength and watertightness. The pipe consists of steel cylinders 14 ft. long, $\frac{5}{32}$ in. thick and surrounded by one, two or three rows of $\frac{5}{8}$-in. spiral reinforcing rods, depending upon the rock condition. The reinforced-steel cylinder is lined at a plant with 2 in. of concrete centrifugally placed, and after placing in the tunnel the sections are electrically welded to form a continuous pipe. The concrete is then pneumatically deposited around the reinforcing bars, completely filling the space between the pipe and the rock. In addition to this backfilling pressure, grouting is carried on outside the pipe, and the joint spaces on the inside are filled and finished smooth. All reinforced-concrete pipe in the shafts has been placed, and more than 1,700 ft. of the tunnel has been lined.

The contract was awarded in July, 1931, the south shaft was completed by November, and the north shaft, requiring the deep caisson operation, was completed May 10, 1932. The tunnel was holed through on May 21, 1932, having been driven almost entirely from the south end. Work was scheduled for completion by June 1, 1933. The project is being carried out by the Greater Vancouver Water District under the direction of E. A. Cleveland, chief commissioner. The contract is held by Northern Construction Co. and J. W. Stewart, Ltd., Vancouver.

Repairing Bridge Piers of Disintegrated Concrete

Freezing and thawing of water in the ungrouted anchor-bolt holes cause trouble—Old concrete removed and new concrete placed under traffic

By J. B. Ferguson
Hagerstown, Md.

DISINTEGRATION of the tops of the piers of the Potomac River bridge at Williamsport, Md., caused by freezing and thawing of water seeping into underground anchor bolt holes, led to a special method of repair which replaced the pier tops with new concrete and did not interrupt traffic. The bridge consists of eighteen 100-ft. spans of through plate girders and has a double-plank floor on creosoted-wood stringers. It was built by the Washington & Berkely Bridge Co. in 1908.

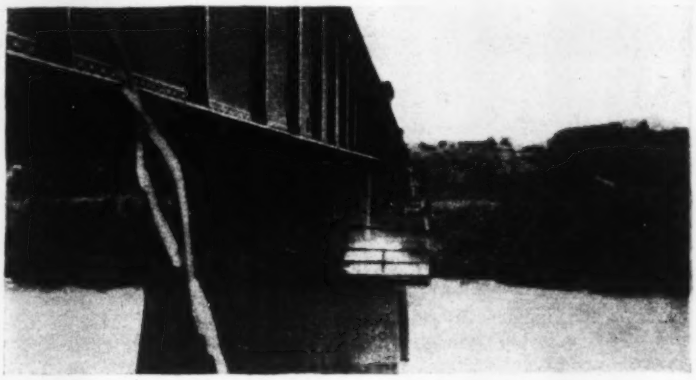


Fig. 1—Piers of bridge at Williamsport, Md., being repaired by casting new concrete under the girders.

Several years ago there was evidence that the concrete in some of the piers was disintegrating. Later examination tended to confirm this, and heavy iron bands were placed around the pier ends in an effort to strengthen them. Careful inspection in June, 1932, revealed conditions that required immediate attention. Original plans of the masonry were not available, but a study of the piers indicated that the trouble was probably caused by water seeping into the ungrouted square bolt holes at each end of the pier, so that freezing and thawing destroyed the concrete. These bolt holes were about 4 ft. deep, and there were four, 6 in. square, on each pier end. Marked evidence of disintegration on the outside of the pier ends, about 4 to 5 ft. down from the top, tended to confirm the opinion that the trouble originated in the interior.

It was desirable to maintain traffic, and the method of carrying on the repair work was as follows: The piers, with two exceptions, are square to the bridge, and were originally built with pedestals above the drain shaft in order to conserve concrete. In later years, in an effort to strengthen the piers, the spaces on the tops of the piers between the pedestal blocks were filled with concrete. At both ends of each girder over the top of the piers are two cross-girders or floor beams. Calculations showed that if traffic were diverted to one side of the bridge, these cross-girders would have sufficient strength to support the main girders with the concrete pedestals cut from under them. As a matter of additional safety and to meet any possible unforeseen weakness in any one girder support, steel beams and rods were used over the ends, as shown in Fig. 3, to make the two adjoining girders function together to some extent.

Access to the pier ends was provided by swinging scaffolds. For the removal of the concrete dynamite was at first contemplated, but it was abandoned in favor of plugs and feathers. With a compressor mounted on a truck and a rotating drill, holes were driven 4 to 6 in. apart, outlining the concrete that was to be removed. The first pier attacked promptly demonstrated that the concrete was even worse than suspected. The chunks were wedged off with surprising ease and upon striking the ground promptly crumbled to stone and dust. While the horizontal depth of concrete removed in the various piers was uniformly about 3 ft., the vertical depths varied from 4½ to 14½ ft.

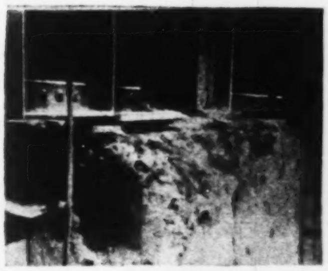


Fig. 2—Freezing and thawing of water that penetrated the pier top through ungrouted anchor bolt holes resulted in serious disintegration of the concrete as shown.

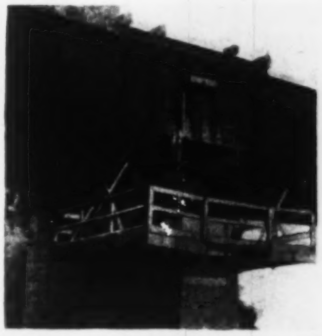
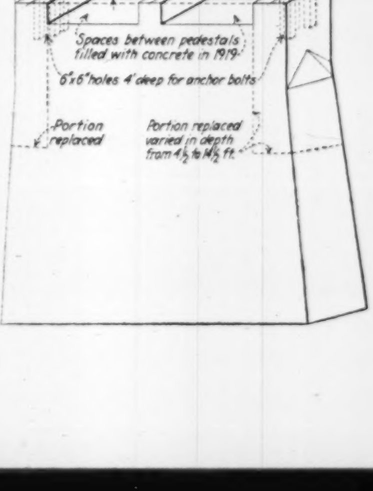


Fig. 3—Main bridge girders were carried during construction by existing floor beams assisted by beam and rod yokes as shown. Traffic was diverted to opposite side of structure during the work.

Upon removal of sufficient concrete, dowel pins 4 ft. long were set in the vertical wall of the cut to a depth of 18 in. and in the horizontal cut to a depth of 12 in., and were grouted in place with sulphur jointing material. The joints between the old and new concrete were protected by painting with asphalt to prevent percolation of water when the joints might later be opened by shrinkage of the new concrete.

It was necessary, when the new concrete had attained sufficient strength, to raise the main girders slightly to get the weight off the end floor beams. Instead of using jacks, the foreman, O. L. Godlove, conceived the idea of

Fig. 4—Typical section of pier of Potomac River bridge at Williamsport, Md., before repair work, which consisted in removal of outside pedestal portion and replacement with new concrete.



CL of girder
CL of girder
25'
3'
8'-6"
2'
8'-6"
3'
5'
18"
18"
11'
11'
CL of pedestal
2'
Spaces between pedestals filled with concrete in 1919
6"x6" holes 4' deep for anchor bolts
Portion replaced
Portion replaced varied in depth from 4½ to 14½ ft.

using the I-beams and rods tying the main girders together. By tightening the rods over one girder it was lifted sufficiently to permit sheet lead to be inserted between the sole and bed plates in order to take the bearing of the end floor beams off the new concrete.

The work was carried out under the superintendence of W. S. Green, with the engineering under the direction of J. Robert Nicklas, both of J. B. Ferguson & Co., Hagerstown, Md.

Scant Headroom Complicates Grade-Separation Problem

By Sidney G. Koon
Queens Topographical Bureau, New York, N. Y.

A UNIQUE method of carrying out a grade separation on Queens Boulevard has been worked out by the engineers of the Board of Transportation and the engineers of the Topographical Bureau of the Borough of Queens in New York City. The task was much complicated by a new subway under construction just below the surface. Current construction made it necessary and economical to build in the grade separation now, as part of that job. The new facilities were opened to traffic on Jan. 7, 1933.

As shown by the accompanying plan two major traffic arteries enter, on opposite sides of the 200-ft. boulevard, only 200 yards apart, and a subway station, beneath the boulevard and between them, will serve both. Nassau Boulevard enters from the northeast, on the north side of Queens Boulevard. Woodhaven Boulevard enters from the south, a little west of where Nassau Boulevard comes in.

Grade separation

It was felt to be unwise to permit through traffic along Queens Boulevard to cross, at grade, the traffic entering or leaving by these other major roads. This hazard was more to be feared in the future than at present, for both entering roads, but more particularly the Nassau Boulevard, will ultimately be extended across Queens Boulevard, instead of merely debouching into it. As shown by the drawing the plan to separate the grades includes: (1) raising the established surface grade along Queens Boulevard over a distance of nearly 1,500 ft., the maximum grade being 4 per cent; (2) carrying the central roadway of the boulevard over the roof of the subway mezzanine. This gives a sort of roller-coaster contour to the depressed roadway, with all grades held to a maximum of 4 per cent.

As shown, the depressed road enters the cut (at either end), goes down a 4 per cent ramp, levels out under the bridge which carries the cross traffic over, rises on another 4 per cent ramp to pass (again level) over the mezzanine, and then repeats this sequence, in reverse order, to pass under the second bridge, and so out of the depression. The portions called level are not strictly so; they are provided with adequate slope for drainage.

Raising of the street surface along Queens Boulevard (and, incidentally, in adjacent parts of all entering streets) was necessary to get the requisite headroom under the two bridges without grades exceeding 4 per cent. Also a bridge clearance of 13½ ft. was accepted in place of 14 ft. demanded generally in other cases.

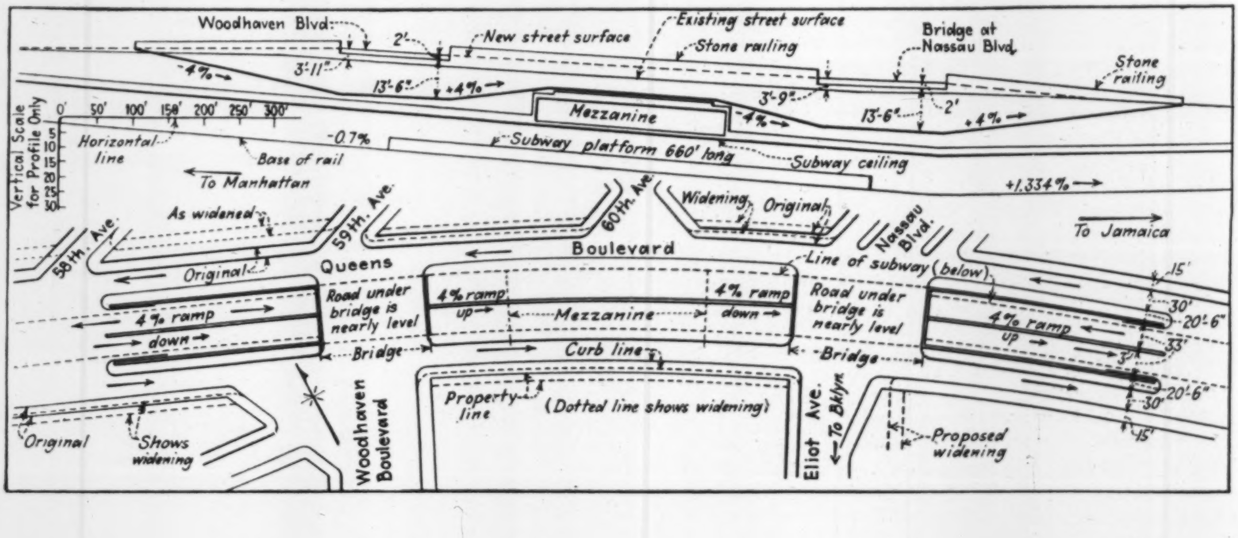
Street widening

Some widening of Queens Boulevard was made necessary by this depression of the roadway carrying through traffic. To accommodate traffic from the west and headed for Nassau and for Woodhaven boulevards, and also that from Woodhaven Boulevard which turns east on Queens (whether going to Nassau or not), the south side of Queens Boulevard was widened 10 ft. for about 1,500 ft. west of Eliot Ave., thus providing one additional traffic lane.

On the north side of Queens Boulevard the situation is a little different. Traffic coming from Nassau Boulevard will be headed largely for Manhattan, and it cannot get at once into the express roadway (here depressed). Hence Queens Boulevard has been widened, again by 10 ft., for 650 ft. west from Nassau Boulevard to where Woodhaven Boulevard enters. Most of the traffic from that artery is headed west toward Manhattan. As it cannot get at once into the express roadway, it crosses the bridge and turns left. To accommodate this large influx, the north side of Queens Boulevard has been widened by 30 ft. (three traffic lanes) from 59th Ave. to 57th Ave., a distance of 700 ft., where it can get at last into the express roadway.

Substantial stone walls along the entire open section are already largely built. The depressed roadway is open to the sky at all points except where passing under the two bridges. A curb 3 ft. wide, running the entire length of the undercut, separates the opposing streams of traffic. Each of those streams has three full lanes, while three lanes are provided, on each side of the Boulevard, for local traffic—making twelve lanes in all. This is increased (over the widened section) to a maximum of sixteen lanes. It is expected that this new road will be open for traffic early in 1933.

Outline plan and profile of street grade separation within limits of headroom set by roof of subway station located at intersection.


Woodhaven Blvd.
2'
New street surface
Existing street surface
Stone railing
Bridge at Nassau Blvd.
Stone railing
-4%
3'-11"
13'-6"
+4%
3'-9"
-4%
13'-6"
2'
+4%
Mezzanine
Vertical Scale for Profile Only
0 5 10 15 20 25 30
0' 50' 100' 150' 200' 250' 300'
Horizontal line
-0.7%
Subway platform 660' long
Subway ceiling
Base of rail
To Manhattan
+1.334%
58th Ave.
59th Ave.
60th Ave.
As widened
Widening
Original
Nassau Blvd.
To Jamaica
Original
Queens
Boulevard
Line of subway (below)
15'
Road under bridge is nearly level
4% ramp up
Mezzanine
4% ramp down
Road under bridge is nearly level
30'
20'-6"
4% ramp down
4% ramp up
33'
3'
Bridge
Curb line
Bridge
20'-6"
30'
15'
Property line
(Dotted line shows widening)
Original
Shows widening
Woodhaven Boulevard
Eliot Ave.
To Bklyn
Proposed widening

Building Hamilton Dam on Colorado River in Texas

Long concrete dam combining multiple-arch and gravity types to develop 126-ft. head for three hydroelectric units of 10,000 kw.

HYDRO-ELECTRIC development on the Colorado River in the vicinity of Burnet, Tex., which has been proposed and investigated at various times, reached a definite stage a few years ago with the organization of the Syndicate Power Co., a local concern whose rights were acquired in 1930 by the Emery, Peck & Rockwood Development Co., Chicago. After a study of the situation it was decided to build three power plants in series and to construct the upstream plant first, as its dam would form a regulating reservoir. This dam is about 10 miles west of Burnet, Tex. A second dam at the Cummins site, 15 miles downstream and just above the mouth of the Llano River, will give about 30 ft. of head, while 50 ft. will be made available by the third dam at the Johnson site, near Marble Falls, Tex., 20 miles farther downstream. The first and main development is named for G. W. Hamilton, consulting engineer, who was connected with the earlier studies of water power possibilities on the Colorado River.

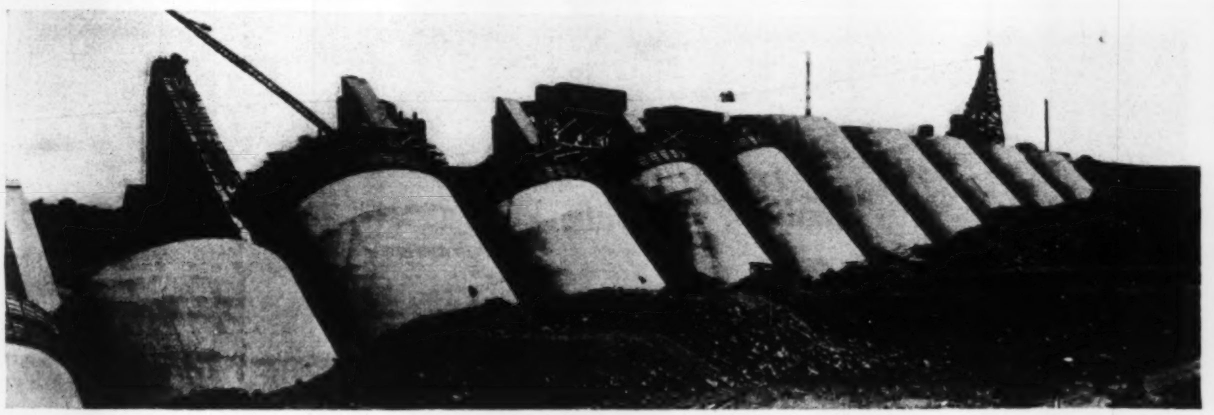


Fig. 1—Multiple-arch sections make up the major part of Hamilton Dam on the Colorado River in Texas.

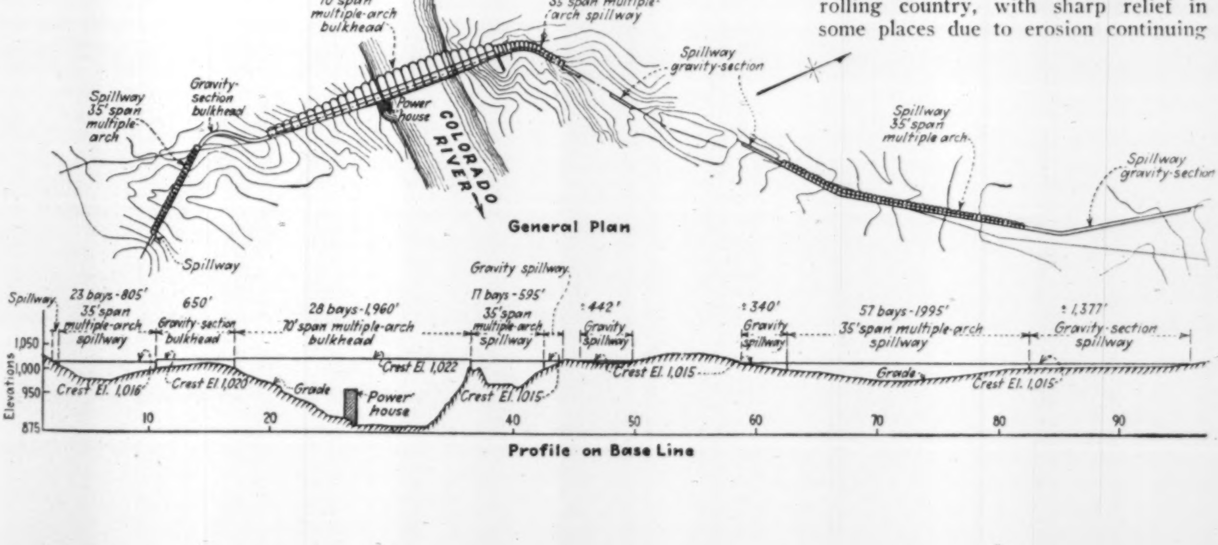
Power contracts were made with the West Texas Utilities Co. and the Central Power & Light Co., of San Antonio, Tex., by which these concerns will take the entire electric output of the three power plants. They will build their own transmission lines. In 1931 the project was taken over by the Central Texas Hydro-electric Co., of Seguin, Tex.

Colorado River reservoir

Hamilton dam, 51 miles northwest of Austin, Tex., by air line and 98½ miles by river above the Austin Dam, will form a reservoir having a drainage area of 31,300 sq.mi., of which the effective area is 19,400 sq.mi. The maximum flood recorded by the U. S. Geological Survey for the Colorado River occurred in 1900 at the time of the failure of the Austin Dam. The discharge at that point has been reliably estimated at 151,000 sec.-ft. just before and 236,000 sec.-ft. immediately after the failure. At the Hamilton Dam, where the drainage area is 6,900 sq.mi. less than at Austin, the spillway has been designed to waste 250,000 sec.-ft., but will safely provide for a flood of double that amount. With the dam completed, the water level will be raised to El. 1,015, giving a maximum depth of about 135 ft. and a surface area of 21,750 acres. At this level the total volume of water will be 900,000 acre-ft., with 800,000 acre-ft. available on a drawdown of 60 ft. With flashboards on the crest to raise the level 5 ft., the volume and available storage will be 1,000,000 and 900,000 acre-ft. respectively.

Topographically, the site is in heavy rolling country, with sharp relief in some places due to erosion continuing

Fig. 2—Plan and diagrammatic section of Hamilton Dam, showing the large spillway area provided.


70'span multiple-arch bulkhead
35'span multiple-arch spillway
Spillway gravity-section
Spillway 35'span multiple arch
Gravity-section bulkhead
Power house
COLORADO RIVER
Spillway 35'span multiple arch
Spillway gravity-section
Spillway
General Plan
Gravity spillway
Spillway
23 bays-805'
35'span multiple-arch spillway
650'
Gravity-section bulkhead
28 bays-1,960'
70'span multiple-arch bulkhead
17 bays-595'
35'span multiple-arch spillway
±442'
Gravity spillway
±340'
Gravity spillway
57 bays-1995'
35'span multiple-arch spillway
±1,377'
Gravity-section spillway
1,050
1,000
950
875
Elevations
Crest El. 1,016'
Crest El. 1,020'
Grade
Power house
Crest El. 1,022
Crest El. 1015
Crest El. 1,015
Grade
Crest El. 1,015
10
20
40
50
60
70
80
90
Profile on Base Line

over long periods of time. Geologically, the underlying rock is a granitoidal formation with some black schist inclusions. Rail access is afforded by the Southern Pacific line from Austin to Llano, which passes within about 4½ miles of the site. A spur was built by the contractor from a new station, called Beverley, to the camp, which has a post office and is called Hamilton Dam.

The series of concrete structures forming the dam has an aggregate length of about 8,377 ft., in approximately L-shape, with the longer leg flanking the north side of the river and providing a long spillway, as shown by Fig. 2. The main portion, extending across the channel of the river, consists of a multiple-arch bulkhead or non-overflow dam, 1,960 ft. long, having 28 bays of 70-ft. span, c. to c. of buttresses, with a maximum height of 154 ft. Its south end is flanked by 650 ft. of gravity bulkhead section, S-shaped in plan, followed by a multiple-arch spillway section having 23 bays of 35-ft. span. A short gravity spillway extends from this section to the hillside.

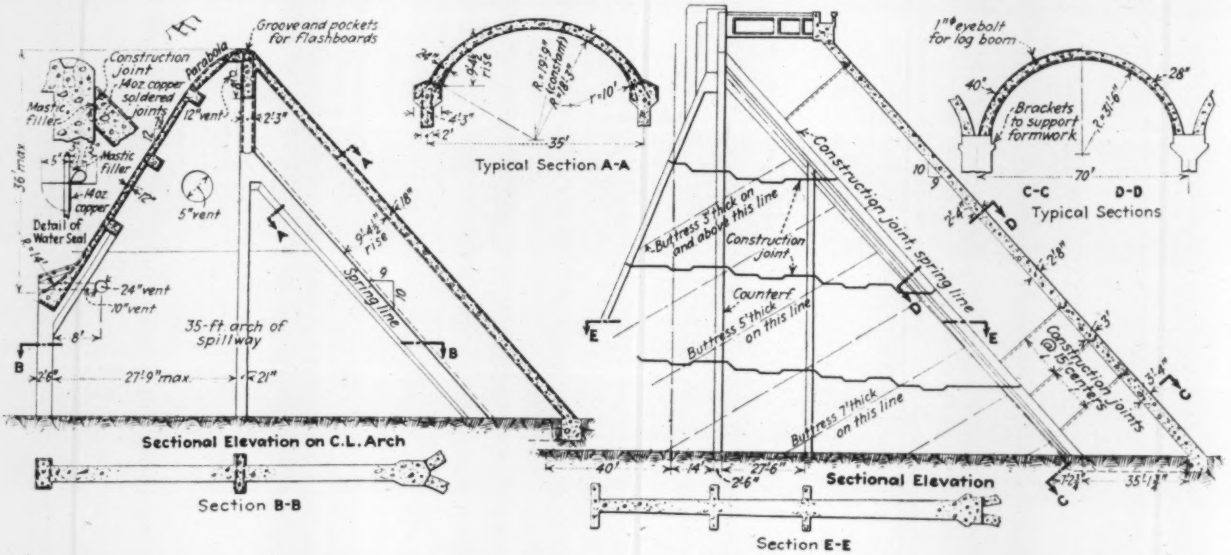

Groove and pockets for flashboards
Parabola
Construction joint
14oz copper soldered joints
Mastic filler
12" vent
2'3"
Mastic filler
14oz copper
Detail of Water Seal
36' max
5'
R=14'
12"
5" vent
A
18"
9'4½" rise
Spring line
9
10
24" vent
10" vent
8'
35-ft arch of spillway
B
B
2'6"
27'9" max.
21"
Sectional Elevation on C.L. Arch
Section B-B
2'
4'3"
9'4½" rise
R=19'9" (constant)
R=18'3"
r=10'
35'
Typical Section A-A
Construction joint, spring line
Buttress 3' thick on and above this line
Construction joint
Counterf.
Buttress 5' thick on this line
Buttress 7' thick on this line
E
E
D
D
10
9
2'4"
2'8"
3'
3'4"
Construction joints @ 15' centers
C
C
40'
14'
2'6"
27'6"
7'2½"
35'1½"
Sectional Elevation
Section E-E
1"ϕ eyebolt for log boom
40'
28"
Brackets to support formwork
r=31'6"
70'
C-C
D-D
Typical Sections

Fig. 3—Typical bulkhead and overflow sections of the multiple-arch portions of the dam.

At the north end of the main dam and extending downstream is a multiple-arch spillway with 17 spans of 35 ft., followed by a gravity spillway which ends at a spur of high ground. Beyond this spur is a long spillway, including a multiple-arch portion with 57 bays of 35-ft. span, between end portions of gravity section. These spillways aggregate 3,395 ft. of multiple-arch type and 2,372 ft. of gravity type, the latter being used where the height of dam does not exceed 25 ft. Of the total 5,767 ft. of spillways, the crest is at El. 1,015 for 4,924 ft. and El. 1,016 for 843 ft.

An earth embankment about 900 ft. long closes a low point about ⅓ mile below the end of the long spillway. This fill, with a maximum height of 10 ft., has a concrete corewall carried down into an impervious stratum and has both sides paved with riprap.

All the concrete structures for the dam are founded on hard, durable rock, mostly granitoid and gneiss. The site was thoroughly prospected by means of diamond drill holes and tested for leakage by water pressure of 115 lb. A concrete cutoff is carried into good rock, and as an additional precaution against percolation under the dam, borings are made at about 10 ft. c. to c. and the holes grouted at the cutoff for the high dam and wherever necessary for the lower sections. Grouting also was done under the buttresses of the high dam wherever the foundation rock would take grout.

River flow during construction

The main dam is being built in two sections, inclosed by cofferdams 18 ft. wide and about 18 ft. high, composed of two lines of 3-in. plank sheeting placed vertically against heavy waling timbers tied together by 1-in. rods having nuts on both ends. The space between the lines of sheeting was filled with red clay from the excavation and spoil from the river bank, topped with about 18 in. of broken rock from the excavation. On the south side the cofferdam inclosed somewhat more than half the width of the river.

To take care of the river flow when the first half of the main dam has been completed and the cofferdam built for the second half of the dam, nine openings 8x8 ft. are provided, three in each of three consecutive arches (see Fig. 8). These openings will finally be closed with steel and timber flap gates, and permanently closed with concrete. A 48-in. gate valve also is installed, to provide for a flow of water for downstream users. These temporary openings are protected by a drift catcher constructed of heavy timbers and cables, 30 ft. high and about 370 ft. long, placed about 60 ft. upstream from the openings. During construction there have been no rises in the river sufficient to cause particular trouble or inconvenience. The highest rise experienced has been 11 ft.

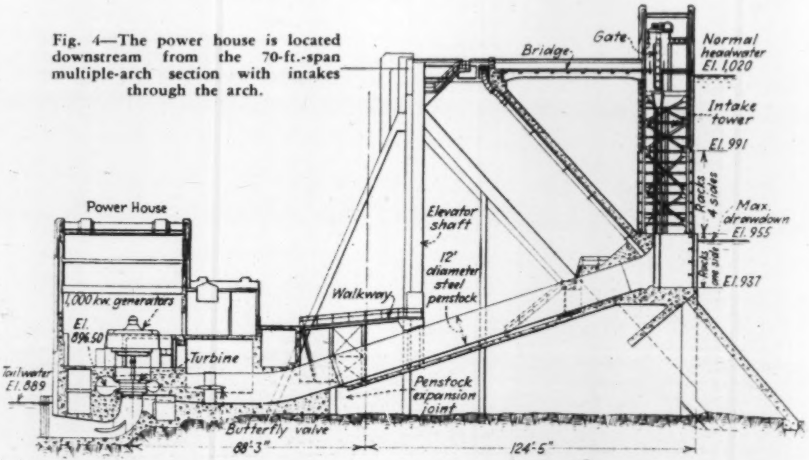

Gate
Bridge
Normal headwater El. 1,020
Intake tower
El. 991
Racks 4 sides
Max. drawdown El. 955
Racks one side
El. 937
Power House
Elevator shaft
12' diameter steel penstock
Walkway
1,000 kw. generators
El. 896.50
Turbine
Tailwater El. 889
Penstock expansion joint
Butterfly valve
88'3"
124'5"

Fig. 4—The power house is located downstream from the 70-ft.-span multiple-arch section with intakes through the arch.

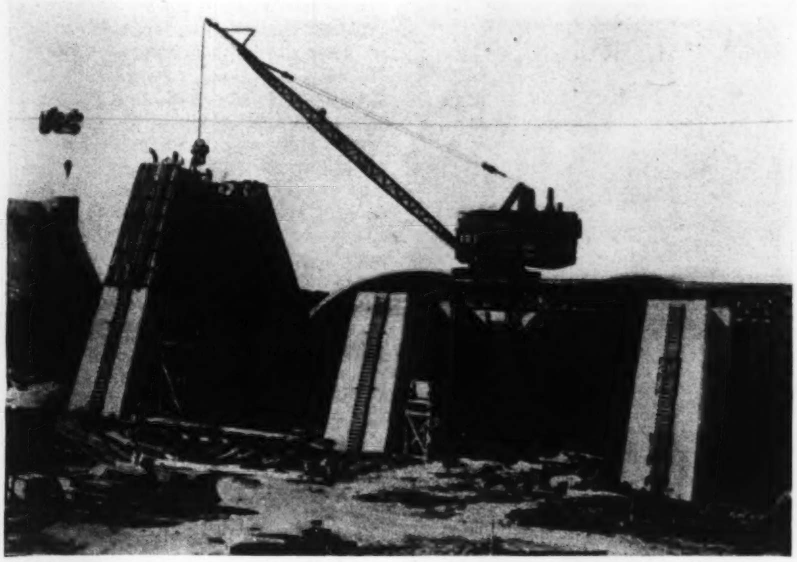


Fig. 5—Concreting abutments for 70-ft. arches of dam. The cableway deposits concrete in a hopper from which a locomotive crane with drop-bottom bucket transfers the concrete to the forms.

This structure will consist of a reinforced-concrete and structural-steel tower built integral with one of the multiple arches of the high bulkhead section at the right or south bank of the river channel. The trash rack area is exceptionally large in order to give a very low velocity through the racks, and a system of pipes for air jets is carried to the bottom of racks to aid in keeping them clear. In the concrete gate house over this intake structure is a 75-ton traveling hoist to handle a truck-type gate for closing off the penstocks when it is desired to unwater them. Access to the gate house is by means of a small elevator running from the platform upstream from the power house to the walkway on top of the dam, then by a foot bridge to the gate house.

The penstocks are 12-ft. steel pipe lines about 165 ft. long, extending from the concrete bell mouths of the intake down to the 12-ft. butterfly service valves at the entrances to the scroll cases. There are two penstocks at present, with the stub of a third bulkheaded until required for a third future unit. The penstocks are aerated by means of 24-in. steel pipes running up under the arch to above head water.

The power house will be of reinforced concrete, with structural-steel frame, on a substructure about 77x108 ft. Local service transformers are to be placed on platforms upstream from the power house. Substation and distribution lines are not yet decided upon, but the substation will probably be south of the power house.

Two power units are to be installed at first, with provision for a third unit. Each unit will have a Francis-type turbine running at 171.4 r.p.m. under 126-ft. head, the head ranging from 65 to 126 ft. The concrete draft tube is of the elbow type.

On the turbine shaft will be a generator of 12,500-kva. capacity for 13,800 volt, 60-cycle, three-phase, alternating current, with thrust bearings of the adjustable shoe type. To handle the machinery there will be a 60-ton electric traveling crane with 10-ton auxiliary hoist.

Concrete and construction plant

Clearing the site of its sparse growth of timber was done by hand, except that stumps were left to be pulled by the draglines when the excavation was in progress. These draglines removed the clay overburden and the blasted rock. Pneumatic drills and paving breakers were used on the rock work. The final preparation and cleaning of the foundation was done by hand, with the draglines serving as cranes to hoist out the material.

Class A concrete, with a specified strength of 3,000 lb. per sq.in. in 28 days, is utilized for the arches, while class B 2,500-lb. concrete is used for buttresses and class C 2,000-lb. concrete for gravity sections. The proportioning and mixing of concrete is under the direct charge of the Southwestern Laboratories, San Antonio, Tex., with D. W. Campbell as local representative. Cylinders are taken from all pours, and frequent compression tests are made in a laboratory at the site. Steel forms are used for all the arches and also for the buttresses.

Sand for concrete is obtained from the Llano River, a few miles downstream from the dam site, and is hauled by truck to a railroad siding and dumped into standard-gage gondola cars which are hauled to the site of the concrete plant at the job. The coarse aggregate consists of dolomitic limestone from a quarry operated by the contractor about ½ mile distant, the stone being hauled to a crushing and screening plant midway between the quarry and the concreting plant. This latter plant has two 1-yd. mixers. Cement and aggregate are weighed automatically and delivered to hopper bins.

Concrete mixed at the central plant is charged into 5-yd. bottom-dump buckets which are carried by a highline cableway and dumped into hoppers. From these hoppers the concrete is delivered to 2-yd. buckets handled by crawler cranes to distribution hoppers. From these hoppers the concrete is either deposited in place by "elephant snouts," flexible sectional spouts, or is carried in buckets by revolving cranes which travel on temporary tracks supported by steel trusses seated on the buttresses of the dam. For a portion of the spillway section out of reach of the cableway, concrete was spouted from a traveling hopper on the trestle to a distribution hopper for crawler distribution.

Forms are left in place until the concrete reaches 1,000-lb. strength for arch decks and buttresses, as determined by

Fig. 7—Setting steel forms for one of the 70-ft. arches of the dam.

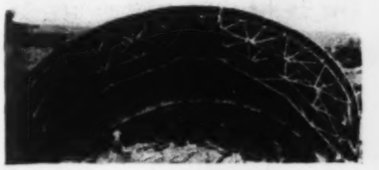


Fig. 6—Concreting 35-ft. arches of spillway. Concrete is spouted to the hopper and handled by a crawler crane.

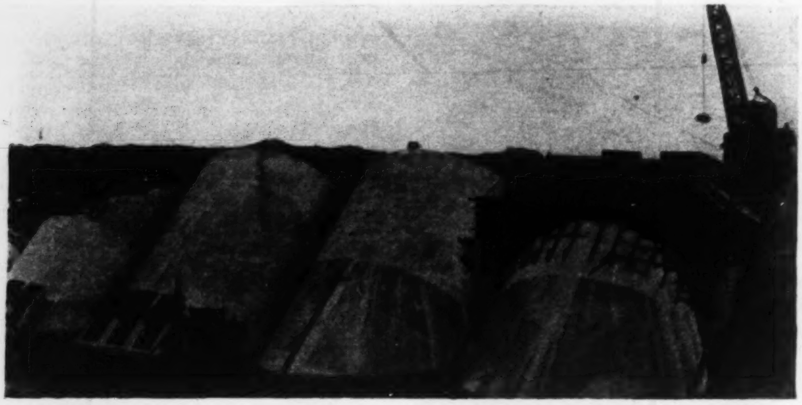


Fig. 8—Lower part of the arches in the channel section, showing at the right the start of the intake.

tests of specimens. This takes three or four days, depending upon weather conditions. The forms are kept wet from the time concrete is poured until it is stripped. Then the concrete is covered with burlap sheets and kept wet for a period of 7 to 28 days, depending upon whether the weather is moist and cool or warm and dry.

Expansion joints have been provided at 20-ft. intervals in the gravity section of the dam. In the multiple-arch section there are no struts between the buttresses, and the design is such that the flexibility of the arches will provide for expansion and contraction movements. Where it is considered necessary to insure against probable leakage, both expansion and construction joints are sealed either by metal water-stops or by pouring asphalt in the joints.

With ten-hour shifts, most of the work has been done on double shifts. Concrete crews, however, have their shifts arranged so that there will not be more than a $\frac{1}{2}$-hour delay between shifts or at any time during placing.

The Fargo Engineering Co., Jackson, Mich., acts as engineer in charge of design and construction, with H. N. Tuley as resident engineer on the job, and Holton Cook as assistant. B. F. Jakobsen, Los Angeles, Cal., and Victor H. Cochrane, Tulsa, Okla., have acted as consultants on the design of the multiple-arch dams. E. H. Sellards, director of the bureau of economic geology at the University of Texas, was consultant on geological conditions and foundation investigations. G. W. Hamilton, Chicago, is consulting engineer for the owners, and F. A. Dale is resident manager at the dam for the Central Texas Hydro-electric Co.

The Fegles Construction Co., Minneapolis, Minn., has the general contract and began work in May, 1931; James Patterson is superintendent in charge; and C. R. Conkey, vice-president and general manager of the company, is on the job much of the time. The turbines are being built by the S. Morgan Smith Co., York, Pa., and the generators and electrical equipment by the Westinghouse Electric & Manufacturing Co. The project is estimated to cost about $6,000,000, exclusive of the two smaller plants to be built farther downstream.

Work on the project was held up temporarily in April of last year due to exhaustion of funds, the owning company having gone into receivership.

Letters to the Editor

"Gunite" and "Cement Gun"

Sir—Within the last few months *Engineering News-Record* has published several articles describing construction work on which "Gunite" has been used, and in each case you have referred to this material, and also to the machine used in placing this material, without capitalization or quotation marks, thereby suggesting that the general usage to which this material has grown seemed to warrant the transfer of these names to the category of common nouns.

We realize that there is no other word by which this material could be described other than by the use of the word "Gunite," because under such designation it has grown to the point that engineers visualize this material as a sand and cement compound which has characteristics of great strength, high resistance to fire, almost absolute imperviousness, and which perfectly binds or welds itself to the surface against which it is applied. On the other hand, we would call your attention to the fact that the word "Gunite" was coined by us in 1911 to describe the product of the machine manufactured only by us and designated by us as a "Cement Gun," and to differentiate it from other mortars or concretes; and it has been due to our intensive promotion effort and expenditure that the use of the machine and its product has become so widespread.

We have always realized that engineers will not use any product unless they can be assured of obtaining proper competitive bidding, and therefore have for more than sixteen years advertised that the machine was not a restricted article but could be purchased and used by anyone, with the result that competition can be obtained on "Gunite" specifications as fully as with concrete where machine mixing is specified. We are, however, jealous of our legal rights in the word which we created as being applied only to this peculiar product, and in order to call the attention of the engineering public to this, we are writing you to say that although you may have used the word as a common noun, we do not release any of our rights of prohibiting the placing of "Gunite" with any other machine than that manufactured by us and sold by us under the trade name "Cement Gun."

We feel that we are acting reasonably and entirely within our rights in requesting you and the public at large to recognize our proprietary interest in the words "Gunite" and "Cement Gun." Their significance to engineers has been created at great expense to us. We seek to preserve their true meaning. We have established that "Gunite" means a certain product of high and definite quality, and as such can be used intelligently in engineering specifications. To permit the word to have any other significance destroys its engineering value and permits the substitution of a cheaper and inferior product.

Allentown, Pa.
Dec. 17, 1932.
B. C. Collier,
President, Cement Gun Co.

The Puerto Rico Hurricane

Sir—Referring to my article published in *Engineering News-Record*, Oct. 20, 1932, p. 470 I beg leave to add the following remarks:

The concrete buildings that failed during the hurricane of Sept. 26 and that were examined by the writer were in all cases deficiently reinforced, as regards both the amount and the position of the reinforcement; and the quality of the concrete was very poor. In most cases it had a porous appearance, showing that either lean mixes or excess water had been used. Furthermore, some of the concrete buildings had wooden partitions and long walls, some more than 100 ft. in length, thus offering to the wind action large areas that did not have the buttressing that concrete partitions would have provided. Such buildings were easily blown down.

There is no doubt in the writer's mind that well-designed and constructed concrete structures, even if designed on an ordinary basis for assumed wind pressures of 30 lb., are entirely cyclone-proof and have the added advantage of being earthquake-proof too.

But adequate engineering design was not and could not have been a common occurrence in Puerto Rico at the time these structures were built. Soon after the American occupation, Brigadier General Davis, U.S.A. issued a military order removing all former restrictions upon, and regulations of, the practice of enginering and architecture and authorizing the unrestricted practice of these professions in Puerto Rico. This had the effect of permitting by law a large number of unqualified so-called "engineers" to practice engineering in competition with a very scant number of really competent professional engineers. This unrestricted practice of pseudo-engineering persisted until 1918, when a law was passed creating a board of examiners of engineers, architects and surveyors, and regulating, in a measure, the practice of the profession. I say "in a measure" advisedly, because this law contained a most liberal, if not vicious, "grandfathers' clause" that was purported to safeguard vested rights, but which in reality afforded the means for unscrupulous persons to legalize their sharp and even piratical practices by merely swearing before a notary public that they had been in the practice of the profession for over three years prior to the date of approval of the law.

The courts have been very liberal in the interpretation of this clause and have issued many writs ordering the examiners to grant licenses to such petitioners.

Few of the really competent engineers are in private practice. Most of them will be found in the employ of the government or with private concerns, because they cannot survive under the keen competition of unethical colleagues or fellow professionals by law without real professional standing.

Under these circumstances it may be realized that a large portion of the engineering work performed in the locality is of indifferent character, and one is not surprised at the large number of failures when conditions out of the ordinary obtain.

MANUEL FONT,
Electrical Engineer,
Public Service Commission.
San Juan,
Puerto Rico.

Surcharge Chart

Sir—In calculating earth pressures against a retaining wall, when there is a sloping surcharge of definite height, I could not find any reasonable method that could be used with ease and give results consistent with the theory of earth pressures. This led me to develop a chart which will give the equivalent water pressure P for any angle of surcharge and ratio of height of surcharge to height of wall.

The chart is made for a material having an angle of repose of $1\frac{1}{2}$-to-1 slope, and it is self-explanatory. Similar charts can be made for other materials if desired. The chart is based on the following calculations. In the figure, let A = angle of repose; B = angle of surcharge; C = any angle considered. The load W between the wall and plane C is reacted by three forces S, T and F, of which F is the only force creating a pressure against the wall. It can be shown that

$$F=\tfrac{1}{2}W.\ \tan\ (C\text{-}A)\ (M^2\text{cot. }C\text{-}N^2\text{cot.}B)$$

and will be a maximum for a certain value of C, which cannot be found by any but trial methods.

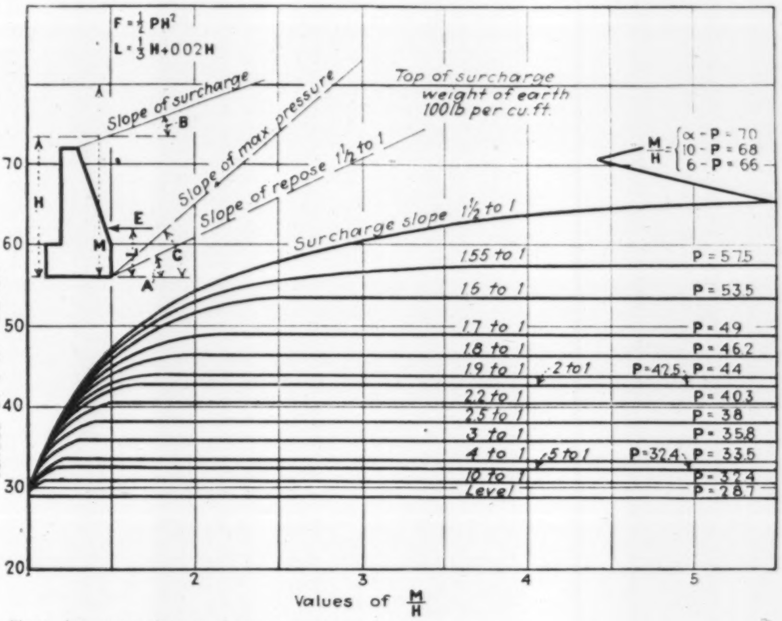


Chart for computing surcharge pressures on retaining walls.

This lends itself to the construction of the above chart, in which P is the pressure intensity in the formula F — $\frac{1}{2} P H^2$ and is given for various values of $\frac{M}{H}$. The chart was made for the angle C that will give a maximum pressure against the wall.

SAMUEL GISSER.
Albany, N. Y.,
Nov. 4, 1932.

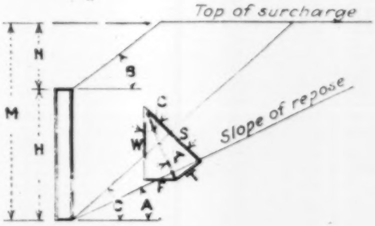


Diagram illustrating derivation of surcharge equations.

Composite Dams Proposed

Sir—C. Maxwell Stanley's article, "Why Not Steel Dams?" (*ENR*, Dec. 1, 1932) presents an idea that I have had in mind for some time.

Two years ago I was engaged on the design of a dam for a hydroelectric power development. The type selected consisted of a concrete spillway section which served principally as a sill to take the bottom of large vertical-lift steel gates. The gates were designed for a maximum head of 49 ft. They had a horizontal span of 37 ft. each and were supported at the ends by channels in concrete piers. The piers were cast monolithically with the concrete spillway section and extended up above the high-water elevation. They also served to support the gantry-crane railway and a highway. Such a design is just as feasible for a fixed dam as for a movable one and suggests another possible type in addition to those described by Mr. Stanley.

The question of economy in materials for dam construction is individual with each case and is complicated by such variable items as transportation costs, available material at the site, etc. However, it has occurred to me that a fixed dam similar to the design described above might prove more economical than one of solid masonry in some cases, and it has an advantage over the designs suggested by Mr. Stanley in that stop-log channels may be installed at little cost. The use of stoplogs would permit the removal of the steel sections for any needed repairs.

The combined use of steel and masonry in bridge construction has been found desirable for many years, but so far as I know little thought has been given to such a combination for fixed dams. The idea suggests some interesting possibilities, e.g., the steel arch rib shown by Mr. Stanley could readily be used to support a reinforced-concrete deck.

R. W. ABBETT,
Instructor in Civil Engineering,
Sheffield Scientific School, Yale University.
New Haven, Conn.,
Dec. 8, 1932.

Engineering News-Record

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JANUARY 12, 1933 Volume 110 Number 2

Value and Improvement

Under the stress of sharply reduced income from their property investments, real estate interests almost everywhere continue their opposition to public improvements and to housing developments, with much aid from mortgage and banking interests. Such opposition has killed or delayed housing acts in several states, and has sought to stop all community improvement in order to reduce tax payments. Natural though it be, this attitude is among the most disturbing developments of the times. It reflects a belief that real estate has some inherent value and that its welfare is a thing apart from the public welfare. The truth of the matter is that the value of real estate is essentially created by the improvements that serve it and by the population for whose use the improvements are provided. Were this fact kept clearly in mind, it would soon teach that opposition to continued improvement tends to render obsolete the very values that it is sought to preserve, for values begin to decay as soon as improvement ceases.

Views of the Voters

An expression of the widespread opposition to even necessary improvements that has been created by economy propaganda is found in the defeat of a proposal for revenue-bond financing of improvements to the San Francisco water system at the recent election. The vote does not show on its face whether it represents dislike of revenue-bond financing in general or whether it is a hostile reaction from repeated bond issues for the Hetch Hetchy development and a conviction that further expenditures for water supply would be excessive. But its effect is to reject definitely the authorization of badly needed improvements. Had the revenue-bond plan been approved, the work to be undertaken could have been financed by an R.F.C. loan. Now such borrowing is definitely forbidden, but the physical needs remain unprovided for. Distribution reservoir capacity within the city is decidedly deficient, present lines from storage reservoirs need to be increased, and sections of distribution mains are loaded to capacity. The department's available revenue is insufficient for pay-as-you-go improvement. Yet the voters of San Francisco have said in effect that they do not want their water system improved, that they prefer to "reduce public expenditures" and leave men idle.

Doubtful Economy

Among the curious economy expedients which governments are now considering or adopting is an interesting method of "saving" which the city council of a Mid-west city now has before it. The plan is to cut expenses in the engineering, park and refuse-collection work by dismissing regular employees and doing the necessary work with relief labor. Its effect is to put regular employees into the breadline in order that those at the head of the line may be given a modicum of work; virtually it taxes a small group of low-paid men to carry a burden that should be borne by the community as a whole. The same senseless procedure has been followed elsewhere, as by stopping useful construction work and eliminating wage-earning in order to use the fund for doles; or, as recommended recently by a legislative committee, by discontinuing highway construction and using the funds thereby released to take care of those thrown out of work by the stoppage of the construction itself. Such plans are common in the day's run of news. The basic principle that business activity is sustained only by continued wage-earning and that welfare funds can come only from gainful employment is blindly cast aside in the frantic effort to take care of the dole problem. The effect of such self-destructive emergency devices is sure to return upon us before long.

Short Hours in City Work

In deciding to maintain a high hourly wage for municipal construction but to utilize it on a short-week or work-sharing basis, San Francisco's board of supervisors has introduced an interesting experiment into the construction field. Rates on private building, recently set by a wage-arbitration body, are much lower per hour, but contemplate an eight-hour day, while the city's decision is for a six-hour day and a thirty-hour week. The daily wages in city and private building will not be far apart, but the city's plan puts to test the important principle of extending the available employment to a greater number of men—a principle which is considered to be one of the essentials of industrial rehabilitation and advance. It remains to be seen how effective the experiment will prove in broadening the employment base. Further, its effect on unit costs is worth watching. On the bare figures alone the decision will not reduce the cost of construction and would leave municipal work at a disadvantage in comparison with private work. But the fact is that reduction in working time has nearly always proved advantageous to all parties, cutting down production costs through increased efficiency, while giving the worker a greater return. If that result should be repeated in the present case, it will stamp the experiment as a noteworthy success and make it a precedent worth following elsewhere.

Reason for Quick Action

Once again a south wind has made Chicago's citizens aware of their water-supply problem. Phenol wastes from the industrial area at the foot of Lake Michigan have been driven to the water intake cribs, and a fortnight of "chlorine cocktails" has ensued. Water consumers have besieged city officials with demands to "do something." The remedy is largely in their own hands. Only by filtration can the chlorine dosage be safely reduced to avoid chlorophenolic tastes. And filtration is financially out of the question as long as the outrageously high water consumption continues. Consumption, in turn, can be curtailed only by metering. Filtration supported by a metering program is economically sound. Filtration alone is hopeless. Long ago engineering plans for a filtration plant were completed. A financial plan has been under study for many months. The credit of the water department is excellent, as the speed with which the $2,300,000 pumping-station loan was obtained from the R.F.C. attests. Metering, Chicago's political bogeyman, is the key. Quick action is in order.

To Speed Up Construction

Force-account construction has been adopted on a long series of tunneling operations by the Metropolitan Water District of Southern California to provide more effective unemployment relief. It is expected that by doing work direct instead of placing it under contract the work can be put under way more speedily and employment can be controlled more effectively. Since the decision was due apparently in part to political pressure, its reasoned character is not assured. Nevertheless it may justify itself if handled in thoroughly effective manner. The expected speeding up in active construction under way will depend on the promptness and energy with which the District's organization enters on the undertaking. Again, how serviceable the job can be made in taking care of idle workers depends on the skill and zeal with which the operations are directed. It must be remembered that contractors are becoming accustomed to bidding and working under restricted employment conditions, so that the argument is not all one-sided. In the background of the case looms up the cost question—whether the force-account operations can be handled as cheaply or as effectively as a contract job. There is always danger in merging the rôles of engineer and contractor, but if the present decision brings tangible results in relieving want and privation during the coming months, it can prove helpful as a temporary policy. In the long run, open bidding is the only sound course.

Building Codes on Concrete

City building codes are beginning to recognize that a single average working stress for concrete is neither economical nor necessarily safe. The new code of Portland, Ore., lists low stresses for the average concrete of "definite" proportions and higher stresses for water-cement-ratio-proportioned concrete, for which control and inspection are demanded. New York City's pending code has a similar provision, although differently worded. These code changes, it should be noted, are important only in that they make available to the field of building construction in these cities the advantages that have become commonplace in other types of construction. Building codes have the reputation of being habitually behind the times, and in the case of concrete the reputation is deserved. Some cities, notably Seattle, made provision for higher working stresses shortly after the Joint Committee on Concrete and Reinforced Concrete in 1921 set working-stress values at 40 per cent of the 28-day cylinder strength. But, by and large, concrete work in cities has had to be designed for 650 lb., regardless of the quality of the concrete. Under the new code provisions, better concrete is rewarded by higher working stresses, provided the owner pays for control and inspection. On some jobs this will effect a saving. On smaller jobs, where expert supervision is not warranted, the lower permissible stresses can be used. This is progress, but the fact that it arrives ten years late should spur cities to revise their codes oftener or at least to make them flexible enough to encompass new advances.

Power to Health Departments

OF MORE than passing interest is the news we reported last week relating to the ruling of the Ohio Supreme Court that an order by the state health department to a city to build a sewage-treatment plant is mandatory and may not be avoided because of the city's tax troubles. The town of Van Wert has been under health department orders for some time to build a treatment plant, but when the health department applied for a mandamus to enforce its order the city pleaded poverty. Its citizens had recently voted down a proposed bond issue to finance the construction of the plant, and an additional tax levy would carry the tax rate beyond the legal limit. The court's ruling declares these reasons insufficient to warrant non-compliance with the orders.

Columbus voters have been sobered by the ruling. Last November they too disapproved a bond issue to build a sewage-treatment plant ordered by the state department of health. On Jan. 13 the city must report to the state its plans for complying with the order. Engineering plans for a new activated-sludge plant are ready, but financial plans are not. It is likely that a direct sewage-service assessment will be necessary to finance a plant suitable to the state. Washington Court House, Bowling Green, Bedford, Maple Heights, Bucyrus and New Bremen are affected by the ruling in a similar manner.

The degree of authority possessed by the state health department varies widely from state to state. In Illinois, for example, the department is limited to "recommending" that a city make certain suggested improvements in sanitary conditions. Even endemic typhoid caused by a polluted water supply cannot be abated through any legal pressure from the health department of that state. Ohio laws, on the other hand, under the recent ruling vest great power in the state health authorities.

It is our belief that in matters pertaining to stream pollution by the discharge of untreated sewage the granting of wide powers to the state authority is good public policy. With few exceptions sewage pollution presents a nuisance and a direct health hazard, not always to the citizens of the community causing the pollution but more often to those of a downstream community. Unfortunately, not many city people are interested in what becomes of sewage as long as their own plumbing fixtures continue to drain freely and their own cellars are not periodically flooded. The municipal back yard may be, and often is, a concentration of filth and yet cause little concern to those who are so proud of their fair city. That their back yard is the front lawn of a different community is seldom considered. Too often the abatement of nuisances like this is accomplished only under legal processes invoked by outsiders. In other words, local initiative is rarely sufficiently unselfish to prevent stream pollution. Hence the need for superior state authority.

The court's ruling has a further aspect in connection with the current deflation in municipal activities. Loud indeed has been the demand that cities contract their operations to bare essentials, but there has been an eloquent silence in regard to what those operations are. Here at last is an authoritative voice that defines one essential activity. "Current expenses must be secondary to levies to meet mandatory requirements, such as discharge of bonded indebtedness, interest thereon, and also compliance with orders of the State Department of Health issued under general state laws, which we hold to be mandatory."

NEWS OF THE WEEK

Loans by R.F.C. Total $15,737,000 at End of Year

AT THE close of business on Dec. 30 the Reconstruction Finance Corporation had paid out a total of $15,737,000 on self-liquidating loans. This amount was distributed as follows: For the New Orleans bridge, $7,000,000 of State of Louisiana 5 per cent bonds, purchased at par; also $6,000,000 of 5 per cent bonds of the City of New Orleans were purchased at par. For the City of Chicago $2,327,000 of city water works certificates were purchased at par. These certificates bear interest at the rate of 5 per cent.

Middle Rio Grande Conservancy District; Bonds to the value of $400,000 were purchased at 90. These bonds pay 5½ per cent.

Bonds of the City of Prescott, Ariz., paying 5 per cent were purchased to the extent of $50,000. These bonds were purchased at par.

Loans authorized up to the end of the year totaled $145,660,000.

First loan this year

Funds for the immediate launching of the Colorado River aqueduct project were made available Jan. 4 to the Metropolitan Water District of Southern California by the Reconstruction Finance Corporation through the Federal Reserve Bank in Los Angeles, Calif. A sum of $2,016,000 was transferred from the bank to the treasurer of the district. The money constitutes the proceeds from the sale of the first block of aqueduct bonds. It is estimated the amount will be sufficient to finance construction of the aqueduct for sixty days.

Applications fall off

Applications for loans under the self-liquidating provisions of the Relief Act have fallen off sharply. Prospective borrowers apparently are awaiting the outcome of proposed amendments to the act. One amendment, which seems likely of adoption, would eliminate the restriction against the use of tax funds in connection with self-liquidating projects. While such an amendment would make it possible for the corporation to grant many applications that cannot now be considered, opponents of the amendment claim that no large number of new applications will be made under such an amendment, due to public objection to the incurring of further tax liabilities.

Congress is not expected to approve a fixed interest rate. In that connection it is pointed out that interest rates vary in different sections of the country. It is not unlikely, however, that the corporation may be given definite authority to refund interest collected in excess of the rate at which the project is refinanced when money becomes available from other than a federal source.

Contract for San Gabriel Dam Goes to West Slope Company

Contract for the construction of San Gabriel Dam No. 1 of the Los Angeles Flood Control District has been let to the West Slope Construction Co. of Los Angeles, as noted in our construction news pages last week, for $8,600,527. The company was the lowest of seven bidders (*ENR*, Dec. 29, p. 794).

The West Slope Construction Co. is made up of Bates & Rogers Construction Co., Chicago; Foley Bros., St. Paul; Foley Bros. New York; and Lawlor & Maguire, Butte, Mont. W. A. Rogers of Bates & Rogers is president.

The dam is to be of rock fill, 375 ft. high, with a concrete face. The successful contractor bid $8,600,527 on the basis of a gunite face and $8,633,032 for a poured concrete slab.

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R.F.C. Money Rates Too High to Attract City of St. Louis

St. Louis Water Department has decided not to make request of R.F.C. for $1,500,000 for extensions but will submit a bond issue to the voters in the spring election. The water department, says J. C. Pritchard, director of public utilities, has never paid more than 4½ per cent on its bonds and it has a balance of $2,000,000 to its credit and is operating even in these times at a small profit. With a bonded indebtedness of $11,000,000 against a $47,000,000 plant no trouble is anticipated in disposing of water bonds locally as these are now selling a fraction higher than general St. Louis bonds. The last sale of the latter was on Dec. 1. They are 4 per cent bonds and were sold for $101.529. Five bids were received on the $6,972,000 issue ranging down to $100.708. With a 4 per cent issue selling for a premium Mr. Pritchard sees no reason to go to the R.F.C. for money.

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R.F.C. Disapproves Application For Detroit Street Widening

The petition of the city of Detroit for a loan from the R.F.C. to hasten the financing of the $10,000,000 Woodward Ave. widening project has been denied by the Corporation on the grounds that the project would not be self-liquidating. A considerable amount of the cost of widening is involved in the real estate condemned for the wider thoroughfare.

Gasoline and weight tax returns to be turned over to the city by the state were to have been pledged as security for the loan, the city officials contending they are special fees paid by motor operators for the use of the highways, rather than direct taxes.

A three-party contract between the city of Detroit, Wayne County and the state of Michigan embraces a general improvement program including the widening of Woodward Avenue and four other main thoroughfares at a probable cost of $28,000,000. Arrangements between the city and the Wayne County Road Commission whereby the county would start immediately on the Woodward widening to give employment to 1,000 unemployed men, the county assuming one half the cost and the city paying the other half over a period of ten years out of money received from the state, have been halted because of lack of assurance on the part of the state that the money would be available. A majority of property owners on Woodward Avenue have agreed to take payment for the required property extended over the ten-year period.

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Supreme Court to Review Purchase of Moffat Road

The Supreme Court of the United States has announced its intention to review the protest against the order of the Interstate Commerce Commission authorizing the Denver & Rio Grande Western Railroad Co. to acquire control of the Denver & Salt Lake Railway Co., the Moffat road.

The Moffat Tunnel League representing communities and property owners in the Moffat Tunnel Improvement District and the Uintah Basin Railroad League claim that one of the purposes of the public construction of the Moffat tunnel was to insure the construction of an extension to Salt Lake City. They contend that the Denver & Rio Grande will not make that extension. All real estate within the Moffat Tunnel Improvement District is subject to the lien of the Moffat tunnel bonds.

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Engineers Added to Staff for Colorado River Aqueduct Work

Six appointments to the executive and engineering staff of the Metropolitan Water District of Southern California have been announced by Frank E. Weymouth, chief engineer and general manager of the Colorado River aqueduct project. The appointments are: B. C. Leadbetter, division engineer; Saul A. Joseph, purchasing agent; J. L. Burkholder, general superintendent of construction on the Coachella project; John Stearns, senior engineer, and DeWitt L. Reaburn and H. E. Warden, tunnel engineers.

Mr. Leadbetter has been engaged as a contracting engineer in Los Angeles for ten years. He formerly was a mining engineer in South Africa and Chile. Mr. Joseph was purchasing agent for the American Steel and Pipe Corp. from 1928 until 1931 and previously was with the National Supply Co. of California.

Mr. Burkholder for the past four years has been chief engineer and general manager of the Middle Rio Grande Conservancy District at Albuquerque, N. M. Mr. Stearns, a Los Angeles construction engineer, was a division engineer on the Los Angeles city aqueduct project and later represented the Metropolitan Water District in negotiations for the purchase of the Pasadena Pine Canyon reservoir. Mr. Reaburn was a division superintendent on the Los Angeles aqueduct project and was the builder of the Mulholland High Way in Los Angeles county. Mr. Warden also was an engineer on the city aqueduct, being a tunnel superintendent, and more recently was in charge of exploration work in connection with the Pine Canyon dam and reservoir in the San Gabriel Canyon.

◆

Force-Account Work on Tunnel Ordered to Speed Employment

Force-account construction work has been ordered by the board of the Metropolitan Water District for some of the shorter tunnel units on the Colorado Aqueduct in the hope that the measure will result in eliminating further delay in putting men at work on the project. The work would be on the tunnels through the Little San Bernardino Mountains where the location permits work to be started simultaneously on many faces. It was the opinion of directors, according to report, that the order would result in putting men to work on these units a month or two faster than it could be done if bids were called.

It was announced that several more items in connection with the project were ready for bidding, including: 180 miles of pipe for temporary water supply line during construction, a 40-mile water supply system to supply the Coachella tunnels, construction of 40 miles of road, building of 131 miles of transmission line and the driving of the Valverde tunnel (7 mi.) and the Bernasconi tunnel (1 mi.). According to Frank E. Weymouth, general manager and chief engineer, there will be about 4,000 men employed on the project by next June.

Eligibility to work on the aqueduct has been set as "resident of the district one year immediately prior to Sept. 29, 1931."

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Labor Union Protests Over Rates To Be Paid on Relief Work

In St. Louis the Central Trades and Labor Union has gone on record as opposed to the program of the Director of Streets and Sewers for the employment of 690 men over a period of 60 days at an average rate of $3.80 a day. This plan would require $159,000 of the $4,600,000 of relief funds voted by the city in the November election. It would be used for traffic surveys and for work on streets and alleys. The union organization contends that the rate is far below the wages being paid for similar work in private and public construction.

In Buffalo, N. Y., the proposal to pay laborers working under the state emergency relief administration $4 a day on relief work is opposed by labor organizations. They would have the regular union wage of $8 a day paid.

Ira Welch McConnell Dies In Buenos Aires

Ira Welch McConnell, former vice-president of Dwight P. Robinson & Co., construction engineers of New York, died of heart disease at Buenos Aires on Jan. 8 at the age of 61. He had been in Buenos Aires for the last five years, supervising the construction of the Lacroze subway. He had passed most of the last ten years in work on South American projects, although he was best known for his irrigation works in the western United States.

Mr. McConnell was graduated from Cornell University in 1897 and returned to the University in 1898 as an instructor in civil engineering. From January to June, 1903, he was professor of civil engineering at the Missouri School of Mines, going from there to the United States Reclamation Service as project engineer on the Uncompahgre Colorado project, the principal items of which were the Gunnison tunnel canal construction. He also was in charge of completion of the Pathfinder reservoir in the North Platte river in south-central Wyoming. During the war he was assistant general manager of the American Shipbuilding Corp. yards at Hog Island. He joined the Dwight P. Robinson Co., Inc., in 1919 as vice-president and remained in this capacity until the property became a subsidiary of the United Engineers.

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Dirt Moved in Actual Start on Golden Gate Bridge Project

Excavation was started Jan. 5 on the Marin County anchorage of the $35,000,000 Golden Gate bridge project at San Francisco. Two power shovels began to clear the site for the anchorage that will hold the north end of the cables for the 4,200-ft. suspension span. The work is part of a sub-contract for the main anchorage contract held by Barrett & Hilp. In the meantime the Pacific Bridge Co., contractor for the two main piers began to move in equipment.

Official starting ceremonies will be held on the San Francisco side of the site Feb. 26. The directors are considering the long list of applications for the position of general manager of the project, left vacant by the resignation of Alan MacDonald last week. The State Supreme Court has extended the time for the filing of briefs to determine the legality of an offer for the bonds which would result in their carrying an interest rate of about 5¼ per cent, or slightly above the recognized legal limit.

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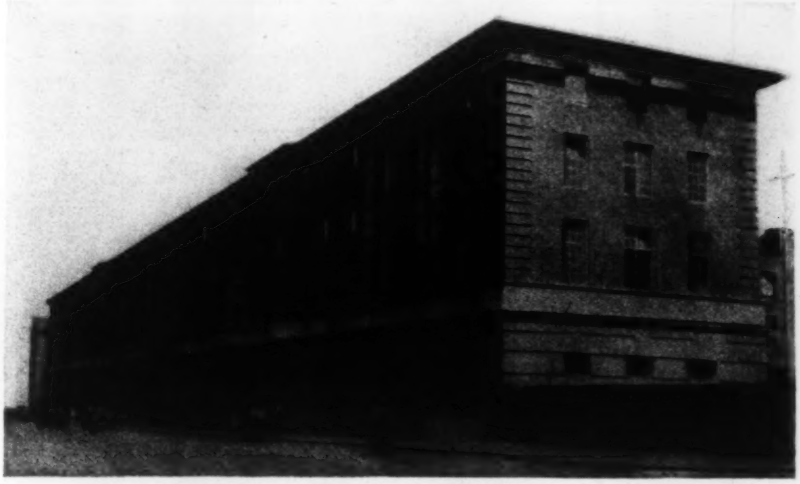
Constitutionality of Power Act To Be Tested in Virginia

The right of the Federal Power Commission to take jurisdiction over a hydro-electric development on a stream which is not actually navigable but which is a principal source of supply for a navigable channel farther downstream is to be brought in question in a case to be heard by Federal Judge Luther B. Way at Alexandria, Va. The case involves the application of the Appalachian Electric Power Co. for a "minor-part license" for the construction of a hydro-electric power plant on the New River near Radford, Va. On April 3, 1931, the commission denied the application and ordered the applicant to apply for a full license on the ground that while the New River at the point of development is not navigable the control of its waters might materially affect navigation in the lower reaches of the river.

The question at issue is of importance as upon it hangs the Federal Power Commission's jurisdiction over many proposed hydro-electric power developments on streams tributary to navigable streams or upon the upper reaches of navigable streams.



NEW RAILWAY STATION IN JOHANNESBURG COMPLETED

At a cost of about $3,500,000 the South African Railways Company has completed a new station at Johannesburg, South Africa. Reconstruction of the Johannesburg passenger facilities was authorized by the Parliament of the Union of South Africa about four years ago and has been in progress ever since. Revamping of the yard layout serving the station also was included in the work undertaken by the company.

The station proper has separate facilities for through and suburban passengers, also separate facilities for Europeans and for Indian and colored passengers, the station for native passengers being placed on a bridge across the tracks at the east end of the station, where third class coaches stop.

Bonding Company Fails Following Contractor's Loss

As a result of experiencing heavy losses in construction bonding, the Union Indemnity Co., of New Orleans, La., was placed in receivership in the Civil District Court at New Orleans on Jan. 6. Three affiliated companies, the LaSalle Fire Insurance Co., Union Title Guarantee Co., and the Insurance Securities Co., the latter a holding company for the group, were placed in receivership at the same time. The company suffered a heavy loss when the Pittsburgh Foundation Co. went bankrupt while engaged in building the southern outfall sewer in Louisville, Ky. Little had been accomplished on the contract and the Union Indemnity Co., together with two other casualty companies, completed the job through a Long Beach, Cal., contractor, Torston Construction Co.

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$10,000,000 Sought From R.F.C. For Irrigation Projects

Applications are pending before the Reconstruction Finance Corporation for loans totaling approximately $10,000,000 to be used in completing twelve irrigation systems in the Lower Rio Grande Valley, according to W. D. Lewis, attorney who is in Washington representing the applicants. All the districts seeking loans have issued bonds, but have found no market for them. They are seeking to make loans and put up the bonds as security, using the funds to complete extensive irrigation works planned. Approximately $25,000,000 of bonds have been issued and not sold by valley irrigation districts. Some of the districts have arranged with contractors for payment in bonds.

Washington Notes

By Paul Wooton
Washington Correspondent

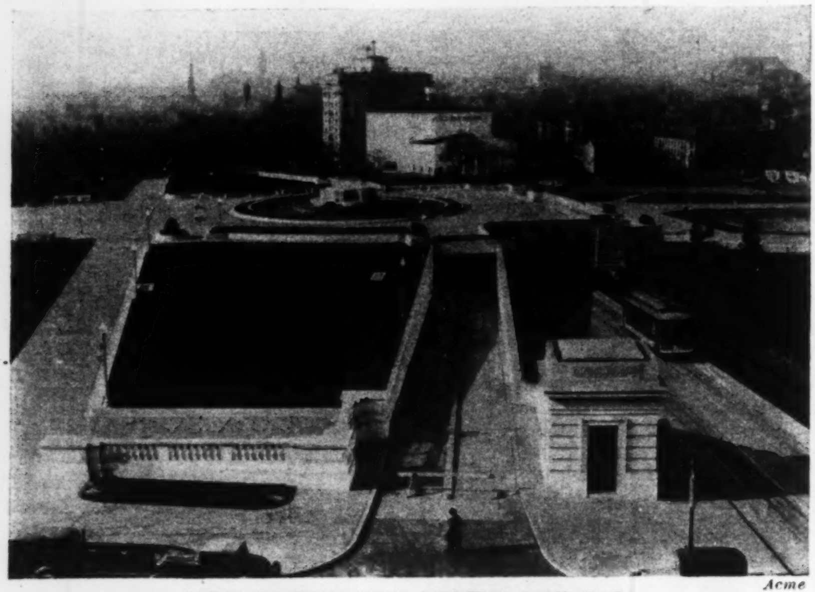
Little progress has been made by the advocates of a new authorization for federal aid for highways. Some members of the Committee on Roads, feeling that the Speaker is against such a bill and finding that many of the former friends of road legislation are apathetic, seem inclined to drop the effort until the special session. In view of Mr. Roosevelt's pre-election commitments they do not see how he could veto an authorization bill.

Representatives Discuss Road Funds

Discussing the road measure on the floor of the House, Rep. Mapes, of Michigan, declared that there is no justification in the present situation for an authorization of $100,000,000. "We ought to stop these appropriations altogether for the building of new highways until conditions improve." He said this was the sentiment of the majority of the people in his congressional district.

Rep. LaGuardia, of New York, called attention to the fact that additional appropriations have been made in recent years to take care of unemployment and that business men, industrialists and the state of Michigan have no ground to complain. Rep. Almon, of Alabama, declared that "it is folly to talk about discontinuing national aid for roads when more people are unemployed than ever before in the history of the nation. There are one million men employed in road construction and in the preparation of materials. I believe that the representatives of the people are going to vote for the bill when it comes before the House for consideration."

The Committee on Roads resumed its sessions on Jan. 10.



Acme

UNDERGROUND CARAGE SUPPORTS PARK PLAZA

The underground garage shown above is in Washington, D. C., located between Union Station and the Capitol and is for the use of members of Congress. It has a capacity of 361 cars. Over the garage there is laid out an attractive park in the center of which is a fountain played upon by colored lights at night. An underground passage allows street cars to pass under the park. The garage covers an area of two square blocks and was built at a cost of $817,000. Parking space is reserved for each of the 96 senators and a sign bearing his name is over his space.

New Railway Lines May Not Be Ordered Supreme Court Finds

A LONG-STANDING question as to whether the Interstate Commerce Commission has the right to order a railroad company to undertake major railway line construction against its will was settled Jan. 9 when the United States Supreme Court ruled that the Transportation Act did not authorize the commission to order the Oregon-Washington Railroad & Navigation Co. to build a 185-mile extension across the state of Oregon.

In December, 1929, upon the urgent request of numerous public bodies in the state of Oregon, the Interstate Commerce Commission ordered the Oregon-Washington Railroad & Navigation Co., a subsidiary of the Union Pacific System, to "extend its line of railroad, now terminating near Burns, Ore., from Crane, Ore., to a connection with the Cascade line of the Southern Pacific Co. at or near Crescent Lake, Ore.," a distance of 185 miles. The new line was for the purpose of providing rail facilities for the rich but sparsely settled region in the foothills of the Cascade Mountains and to establish a new east and west line across the southern part of the state. The order was issued over the protest of the railroads concerned on the ground that the line would not develop sufficient traffic to warrant the expenditure required for its construction, also on the ground that the Commerce Commission exceeded its authority in ordering the construction. Later the railroads petitioned the district court for the district of Oregon to set aside the order. This the court did and the U. S. Supreme Court has now confirmed this action.

Commenting upon the commission's action, the court said, 'The commission thought its authority to order extensions of existing lines was without limitation, save the two which are expressed in paragraph 21 (of the Transportation Act) that public necessity and convenience require the construction, and that the building and operation of the road will not impair the ability of the carrier to render adequate public service. Having determined that the requested extension complied with both conditions the commission ordered the road built.

"Prior to the adoption of the Transportation Act, 1920, the commission had no authority to authorize or to compel extension of existing lines of railroads. Such power as exists in that behalf rests in the state. 'In a number of cases this court passed upon and defined the authority of the state to require extensions of existing services and facilities. Orders made were attacked as compelling the companies, against their will and judgment, to devote properties to the public service without compensation, contrary to the guarantee of due process. They were sustained, however, upon the express ground that the railroads had undertaken service and must supply facilities adequate and reasonably necessary to its performance. The requirements were found not to involve the rendition of a new or different service from that to which the owners had agreed when they dedicated their property to public use. Where, however, the state's mandate involved the rendition of a service beyond the agreement of the carrier, the order was annulled."

Section 21 of the Transportation Act provided that the commission may "authorize or require any carrier by railroad to provide itself with safe and adequate facilities for performing as a common carrier its car service as that term is used in this act, and to extend its line or lines; provided that no such order shall be made unless the commission finds, as to such extension, that it is reasonably required in the interests of public convenience and necessity, or as to such extension or facilities that the expense involved therein will not impair the ability of the carrier to perform its duty to the public."

Commenting on this section of the act, the court said, "The phrase 'and to extend its line or lines' is part of a single sentence committing to the commission the power to require carriers to provide safe and adequate facilities for car service as defined in the act. The reasonable conclusion is, therefore, that the extensions mentioned have to do with car service, and are not intended to create a wholly independent subject or jurisdiction. We should expect, if Congress were intending to grant to the commission a new and drastic power to compel the investment of enormous sums for the development or service of a region which the carrier had never theretofore entered or intended to serve, the intention would be expressed in more than a clause in a sentence dealing with car service."

"The act, reasonably construed, distinguishes between three sorts of facilities —new lines or extensions, voluntarily undertaken (section 18); compulsory extensions within the area which the carrier has bound himself to serve (section 21); and spurs, industrial, team, and switching or side tracks located wholly within one state, which are left within state control (section 22). The second class is distinct from the others and embraces, as the decision shows, a substantial field. But this field is not, as the commission holds, coterminous with that created by paragraph 18. If it were, power would exist to compel a carrier having lines between Chicago and St. Louis, but none connecting these cities to build a railroad between them. . . . We cannot so read the statute, but think the power granted by paragraph 21 is confined to extensions within the undertaking of the carrier to serve, and cannot be extended to embrace the building of what is essentially a new line to reach new territory."

Those favoring the construction of the line made much of the fact that the railroad company held a charter to build a line across the state substantially as required in the Interstate Commerce Commission order. On this point the Supreme Court said, "The possession of a charter which would have made the building of a railroad legal is insignificant as to the company's actual undertaking. Whether the railroad held itself out to serve the region, the question must be decided in the light of all the facts. The record demonstrates that the territory to be traversed was one the company had neither actually nor impliedly agreed to serve with transportation facilities."

A dissenting opinion was rendered by Justice Cardozo and it was concurred in by Justice Brandeis and Justice Stone. Justice Cardozo held that the transportation act was designed to provide the country with an adequate railway system and that it gave the commission both the authority to keep railroads from building lines which might result in wasteful expenditures and also to compel them to build lines needed for the development of the country.

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SOCIETY CALENDAR

AMERICAN CONCRETE INSTITUTE, annual meeting, Chicago, Feb. 21-24.

AMERICAN ENGINEERING COUNCIL, annual meeting, Washington, Jan. 15.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, Detroit, Mich., Jan. 16-18.

AMERICAN ROAD BUILDERS ASSOCIATION, annual convention and road show, Detroit, Mich., Jan. 16-18.

AMERICAN SOCIETY OF CIVIL ENGINEERS, annual meeting, New York, N. Y., Jan. 18-21.

AMERICAN SOCIETY OF MUNICIPAL ENGINEERS, annual meeting, Detroit, Mich., Jan. 16-18.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, annual convention, Cincinnati, Ohio, Jan. 20-25.

AMERICAN TOLL BRIDGE ASSOCIATION, annual meeting, Camden, N. J., Jan. 16-17.

AMERICAN WOOD PRESERVERS ASSOCIATION, Chicago, Ill., Jan. 24-26.

ASPHALT INSTITUTE, Asphalt Industry Conference, Detroit, Mich., Jan. 18.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, annual convention, Detroit, Mich., Jan. 16-18.

CONSTRUCTION LEAGUE OF THE UNITED STATES, Detroit, Mich., Policy committee assembly, Jan. 21.

HIGHWAY AND BUILDING CONGRESS participated in by twenty national engineering societies and trade associations, Detroit, Mich., Jan. 16-20.

INTERNATIONAL ASSOCIATION OF PUBLIC WORKS OFFICIALS, Detroit, Mich., Jan. 17.

ENGINEERING INSTITUTE OF CANADA, annual meeting, Ottawa, Ont., Feb. 7-8.

NATIONAL CRUSHED STONE ASSOCIATION, annual meeting, Detroit, Mich., Jan. 16-18.

NATIONAL SAND & GRAVEL ASSOCIATION, annual meeting, Detroit, Mich., Jan. 16-18.

NATIONAL READY MIXED CONCRETE ASSOCIATION, annual meeting, Detroit, Mich., Jan. 17-18.

PORTLAND CEMENT ASSOCIATION, Detroit, Mich., Jan. 16-18.

MONTANA SECTION, American Water Works Association, will hold its annual meeting on April 21-22 at Havre, Montana. On April 19-20 there will be held, also at Havre, a two-day school or short course for waterworks operators.

SEVENTH ANNUAL HIGHWAY ENGINEERING CONFERENCE will be held at the University of Colorado, Boulder, Colo., on Jan. 19-20. Representatives from six states will discuss construction and maintenance problems incident to bituminous mat highway surfaces, including methods of selecting and testing road oils suitable for this purpose.

LOS ANGELES SECTION, American Society of Civil Engineers, has elected the following officers; president, Ormond A. Stone; vice-presidents, Gerald FitzGerald and Alfred Jones; secretary, Andrew L. Gram.

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Obituary

John J. Brown, who resigned in November, as a member of the Indiana State Highway Commission, to accept appointment on the State Tax Board, died of a heart attack on the night of Jan. 7 in Indianapolis. Mr. Brown was 62 years of age. He had been a director of the Highway Commission since 1928, and from 1919 to 1928, was a member of the State Tax Board.

Branch H. Colby died on Jan. 4 at his home at Normal, Ill., at the age of 78. From 1878 to 1884 Mr. Colby was assistant United States engineer for the Mississippi River Commission. During the war he supervised the building of steel ships at Hog Island, Pa., and of the government shipyard at San Francisco.

William S. Dinwiddie, head of Dinwiddie Construction Company, Portland, Ore., and Berkeley, Calif., died at his home in the latter city Dec. 22 at the age of 65. He was well-known in contracting and engineering circles on the Pacific Coast, having come to Portland in 1906. His company constructed many of Portland's business structures and lately has been similarly engaged in California.

Percy M. Blake, retired civil engineer, who had constructed water supplies in many cities and towns throughout New England, died on Jan. 4 at his home in Newtonville, Mass., after a long illness. Mr. Blake was born in 1850. For a time he was in the engineering office of Cushing Farnum in Providence, R. I., and from 1872 to 1875 he was assistant civil engineer with General G. K. Warren in the United States Engineering Corps in the Department of River and Harbor Improvements. Later he became a consulting engineer and during the latter part of his career specialized in sanitary and hydraulic engineering.

John Gordon McFee, president of Henry McFee Contracting Company, Seattle, died in that city recently at the age of 70 years. Mr. McFee was born in Quebec, in 1863, coming to Seattle, Wash., in 1890. There he became general superintendent for H. C. Henry in constructing sections of the Chicago, Milwaukee & St. Paul Railway, the Oregon Trunk Railway and the Southern Pacific Railway, and also large pier projects for the Puget Sound Navy Yard at Bremerton. From 1906 to 1923, he was manager of the co-partnership of Henry & McFee, general contractors, and 1923 formed the firm of which he was president at the time of his death.

Frank C. Kelsey, president of the Continental Pipe Manufacturing Co., Inc., New York City, died January 4. Mr. Kelsey was born in Boone County, Ky., in 1862. For several years he was connected with the Atchison, Topeka & Santa Fe Railroad, the Denver & Rio Grande Railroad, and the Union Pacific Railroad. Later he was city engineer of Salt Lake City, Utah. Since then he was in general practice in the northwest, including chief engineer and designer of the Nisqually Power Plant for the city of Tacoma, Washington, and other large engineering work. For the past seven years Mr. Kelsey was president of the Continental Pipe Manufacturing Co., Inc., constructing large pipe lines for hydro-electric plants.

C. M. Einfeldt, member of the Denver Board of Water Commissioners, and a mechanical and electrical engineer, died late in December. He had been a member of the board since June, 1931, and had takn an active part in pushing the 75-m.g.d. University Park pumping station now renamed after him. The recent reduction in the water rates made it impossible to finance the completion of the project from revenue so that Mr. Einfeldt was vitally interested in obtaining the money from the R.F.C. Another service to the city was in negotiations for a contract for electricity whereby all the pumping stations could be served by the Public Service Company under a consolidated power demand charge, thereby greatly reducing the power bill.

◆

New I.C.C. Building Scaffolding Burns

On the night of Jan. 6 fire destroyed the wooden scaffolding around the uncompleted Interstate Commerce Commission building in Washington. Known damage caused by the fire is estimated at $40,000. There is a possibility that further damage may have been done to the steel work of the building which was in progress of erection. Neal A. Melick, construction engineer supervising work on new buildings for the federal government, said a careful check of the steel work would be made before construction is resumed in the damaged section. The building is being constructed by the James Stewart Co.

◆

Second Express Highway Section Opened in New York

The second section of the New York west side elevated express highway, the stretch between 22d and 38th Sts., was formally opened on Jan. 5. The highway is now open for continuous flow of traffic from Canal St. to 38th St. The opening of the section is timely, it has been pointed out, because 11th Ave., the street to the east, will be virtually closed by the New York Central reconstruction of its 30th St. freight yard in accordance with the West Side improvement plan. Work on the foundations for the third section, from 38th to 48th St., is nearing completion and bids for the superstructure will be received in the near future.

A saving of $10,000,000 in the original estimate of the cost of constructing the entire highway from Canal to 72d St. has been made possible by lower cost of materials and other factors. It has been announced that the entire highway, 4½ miles long, probably would be in use by the end of the present year. The total estimate for the foundation and superstructure of the second section was $3,538,822 whereas the actual cost of construction has been $2,391,351. The contractors were Poirier & McLane Corp.

◆

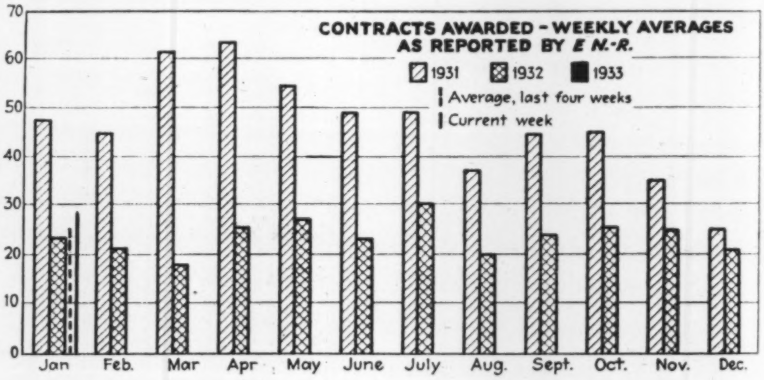
Engineering Contracts and Capital

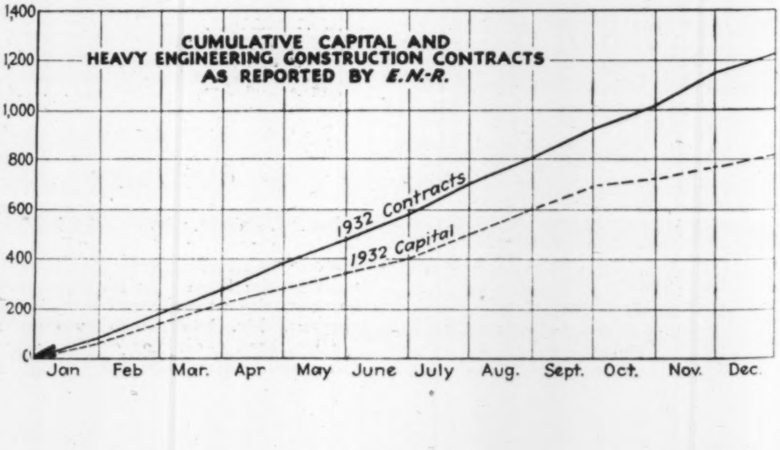
HEAVY ENGINEERING construction contracts reported during the past week total $27,551,000, which, following a high total of $38,329,000 reported for the previous week, gives construction a flying start in 1933, the first two weeks showing a gain of 50 per cent over the similar period of last year. A spurt in private contracts was responsible for part of the good showing of the present week, this class of awards totaling $8,999,000, as compared with a weekly average of less than 3 millions for the past several months. This is the highest weekly total reported for private work since last July. Public contracts held up well; amounting to $18,552,000. The average of contracts awarded the past four weeks is as follows: private, $4,826,000; public, $20,859,000; all, $25,685,000. Federal awards during the past week showed considerable gain over the previous week, but were well below average for the past several weeks, amounting to $2,318,000. Highway lettings were unusually strong last week, aggregating $10,387,000, the highest week since Oct. 20.

Large contracts reported during the week include: highways, Illinois, $2,340,000; highways, New York, $1,864,000; factory, Perth Amboy, N. J., $1,000,000; levees, Louisiana, $1,057,000 and betterments to a gas distribution system, day labor, eastern states, $3,756,000.

A low bid of $5,996,000 was received for the federal court house, New York City. Bids will be called for soon on a new building for University Hospital, Baltimore, $1,000,000 and for a post office and federal building at Columbus, Ohio, $2,275,000. Prominent in the proposed list are a federal office building, Buffalo, estimated at $2,000,000 and a park development at Stratford, Conn., to cost $1,500,000. The Philadelphia Electric Co. is planning additions and betterments to its Richmond station to cost $9,000,000.

New capital issues reported during the week total $15,500,000, of which $11,274,000 represents productive issues of private firms. Leading the public issues was a $2,000,000 issue for Los Angeles waterworks.





Contracts and Capital

CONSTRUCTION

(Thousands of Dollars)

	Weekly Average Jan., 1932	Four Weeks	Week Jan. 12, 1933
Federal government	$4,155	$2,735	$2,318
State and municipal	9,289	18,124	16,234
Total public	$13,444	$20,859	$18,552
Total private	9,951	4,826	8,999
Week's total	$23,395	$25,685	$27,551

Cumulative to date:

1932	$46,790
1933	65,880

NEW PRODUCTIVE CAPITAL

(Thousands of Dollars)

	Weekly Average Jan., 1932	Four Weeks	Week Jan. 7 1933
R.F.C. loans made	......	$3,750	......
New capital issues	$17,750	12,400	$15,500
Total	$17,750	$16,150	$15,500

R.F.C. self-liquidating loans:

Approved to date (including 1932)	$145,660
Actual loans made (including 1932)	17,753

◆

ENR Cost and Volume Index

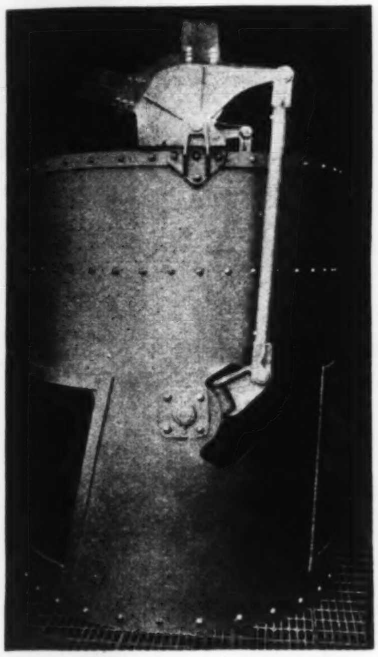
E.N.-R. Cost		E.N.-R. Volume	
January, 1933	**158.44**	**December, 1932**	**113**
December 1932	158.46	November, 1932	137
January, 1932	162.48	December, 1931	133
1932 (Average)	156.97	1932 (Average)	127
1931 (Average)	181.35	1931 (Average)	220
1930 (Average)	202.35	1930 (Average)	260

1913 Average....... 100

Construction Equipment and Materials

New Concrete Bucket of Large Capacity

A new form of concrete bucket of 2-cu.yd. capacity has been developed by the Blaw-Knox Co., Pittsburgh, Pa. The manufacturer states that the bucket meets the many requirements encountered in the placing of large quantities of concrete and is especially well adapted for subaqueous work. The new bucket is of cylindrical form, consisting mainly of an inner and an outer shell. The outer shell is a true cylinder extended to form a base for supporting the bucket while it is being filled. The inner shell is a flat cone, the discharge end of which is oval. It requires two hook blocks for operation and is commonly termed a 2-line type.


New concrete bucket by Blaw-Knox

The discharge gate is operated by a twin bail, to which it is connected by thrust rods in such a manner that any movement of the twin bail is communicated directly to the gate. These bails are built rigidly together and pivoted at bracket connections on each side of the bucket, located slightly off center. The purpose of this off-center location is to insure the bail being held rigidly against its stop, when the filled bucket is supported in the air, thus introducing a positive force tending to keep the gate in closed position so that it will not respond freely to any pull exerted by the resistance to cable overhaulage on the dump hook block.

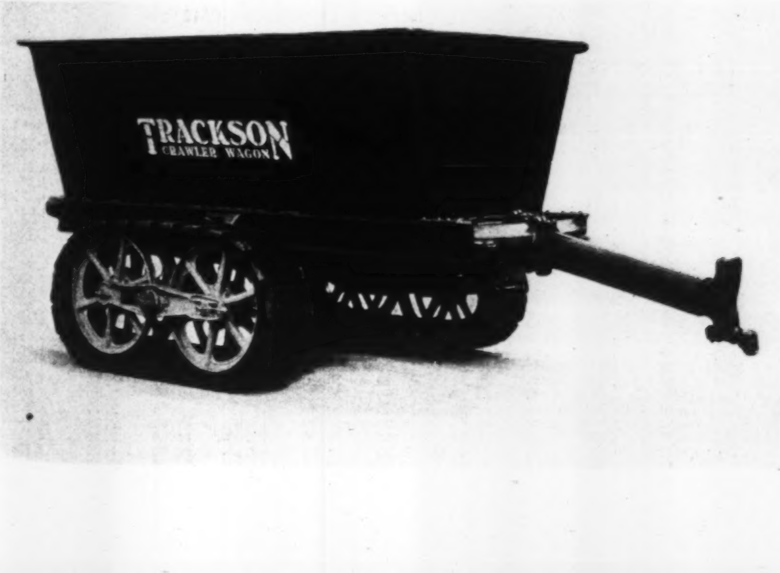
◆

Large-capacity Crawler Wagon For Dragline Loading

Trackson Company, Milwaukee, Wis., announce the "Levee Special," a larger capacity wagon, especially constructed for dragline loading. This new wagon has a water-measure capacity of 9 cu.yd., or 11 cu.yd. heaped material, and provides about 40 per cent greater capacity in comparison with the same company's standard wagon. It is intended for use in conjunction with the larger-sized draglines and crawler tractors now coming into use on large earth-moving projects.

The Levee Special is of the bottom dump, cart-type. Unloading takes place through the full-length bottom doors and consequently the load is dumped almost instantaneously with the release of the doors. About 90 per cent of the total load is carried on crawler wheels with the remaining weight overbalanced onto the tractor through the rigid tubular tongue. In addition to the load being supported entirely by crawlers, the cart-type has the added advantage of being practically proof against jack-knifing in descending steep grades.

"Levee Special" for large earth-moving projects.



New Equipment in Brief

Colored Pencils. A new line of drawing pencils is announced by the Joseph Dixon Crucible Co., Jersey City, N. J. The leads are completely water soluble and the pencil may be used over wet paper or dipped in water for unusual water color effect.

Centrifugal Pump. The Novo Engine Co., Lansing, Michigan, announce an addition to their line of self-priming centrifugal pumps. It is a 2-in. pump with a capacity of 7,500 gallons per hour, at a 15-ft. lift and a total head of 55 ft. The new pump is featured by a leather seal used to replace the conventional packing. The self-priming action is performed by the recirculating method. The outfit is completely equipped with anti-friction bearings and is driven by a 2-hp. engine.

Gasoline Locomotive. The Brookville Locomotive Co., Brookville, Pa., has recently announced their new "B-1-30" series supplied standard in all gages, in 4, 5, 6, and 7-ton weights. The power unit is the new "I-30" McCormick-Deering Industrial tractor, especially designed and manufactured by the International Harvester Co. Locomotive features have been held to essentials, including a heavy unbreakable steel frame, sanders, dual brakes, and dual-spring journal boxes. Steel tired drive wheels are standard equipment.

Drill Sharpener. A new well-drill-bit sharpening machine has been announced by Ingersoll-Rand Co., 11 Broadway, New York, N. Y. New bits can be forged on blank steels in two or three heats, and dull bits can be redressed in one heat. The WD sharpener is claimed to make perfectly formed bits which are concentric with the steel and accurate in gage and in other details. The sharpener occupies small floor space and operates entirely by compressed air, all operations being controlled by a single throttle at a convenient position. A powerful crosshead delivers the forging blows when forming the bit, and it clamps the steel while a dolly, actuated by a powerful cylinder, rapidly forges the face of the bit.

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Business Notes

National Machine Tool Builders Association states that on November 1 its address was changed from Cleveland, Ohio to 1415 Enquirer Building, Cincinnati, Ohio.

Rex-Watson Corp. of Canastota, N. Y., announces the appointment of Clayton S. Carris, of Savannah, N. Y., as Western New York representative.

The Whitcomb Locomotive Co., Rochelle, Ill., subsidiary of The Baldwin Locomotive Works, has announced its acquisition as of July 19th of the business, inventory and good-will of the **Milwaukee Locomotive Manufacturing Co.** under a plan whereby Westinghouse Air Brake Company, formerly the owner of Milwaukee Locomotive Manufacturing Company, becomes a stockholder in the Whitcomb Locomotive Company. The sales of Milwaukee locomotives and parts will be conducted by The Whitcomb Locomotive Company through its home office at Rochelle, Ill., and through its district offices and agents.

The Jeffrey Manufacturing Co., Columbus, Ohio, has announced the removal of its Southwestern branch office from Houston to Dallas, Texas. T. P. Burke continues as manager.

Link-Belt Co., Chicago, Ill., announces that it has recently appointed George M. Sharer sales manager of its eastern division with headquarters in Philadelphia. In this capacity, he has direct supervision of sales of all of the company's offices in the Atlantic Coast States.

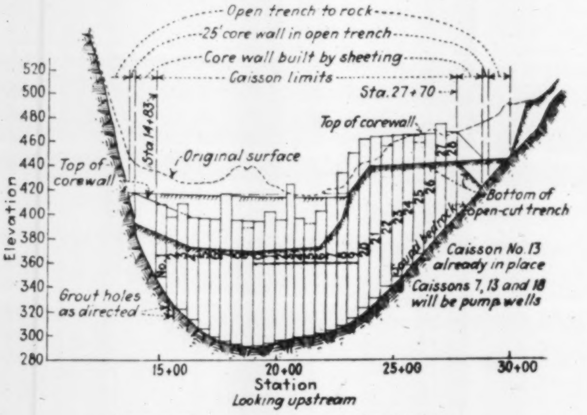
Unit Prices—Pneumatic Caissons for Corewall, Quabbin Dike, Mass.

CONTRACT WAS AWARDED Dec. 28, 1932, by the Metropolitan District Water Supply Commission of Boston for the sinking of 27 pneumatic caissons for the corewall of the Quabbin Dike, part of the Swift River development, near Enfield, Mass. Bids were received from 25 firms, ranging from $999,265, contract, to $2,344,177. The low bidder, West Construction Co. of Montreal and Boston, received the contract. Each caisson will be 45 ft. long and about 9 ft. wide. A concrete seal will be placed between boxes. One caisson has already been sunk for exploratory purposes by the Dravo Contracting Co. This firm stood eighteenth in the list of bidders for the remainder of the work. An open cut will be excavated along the line of caissons and backfilled with a rolled fill.

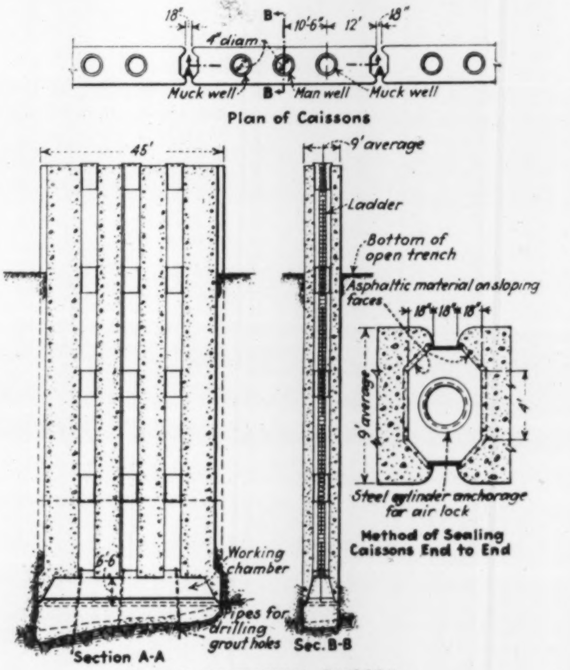
Table I gives the complete unit prices of the three low bidders. (A) West Const. Co., contract; (B) C. & R. Const. Co., Roslindale, Mass.; (C) J. F. Fitzgerald Const. Co., Boston. Table II lists the total of each bid and the unit prices of principal items, the item numbers corresponding to those described in Table I. Frank E. Winsor is chief engineer of the Metropolitan District Commission.

TABLE I—COMPLETE UNIT PRICES OF THREE LOWEST BIDDER

Item	Description	Quan.	Unit Prices		
			(A)	(B)	(C)
1	Earth exc. open cut to El. 400, c.y.	250,000	$0.19	$0.50	$0.22
2	Earth exc. open cut below El. 400, c.y.	70,000	.20	.50	.34
3	Rock exc. (boulders) open cut, c.y.	9,500	.50	.50	.68
4	Rock exc. (ledge) open cut, c.y.	300	8.00	3.00	4.00
5	Stripping, c.y.	65,000	.20	.45	.52
6	Unconsolidated embankment, c.y.	20,000	.10	.10	.03
7	Consolidated previous emb., c.y.	260,000	.12	.05	.11
8	Rolled impervious embank., c.y.	160,000	.36	.25	.18
9	Gravel surfacing, c.y.	4,000	.45	.25	.70
10	Brook diversion, lump sum	......	5,600	35,000	8,917
	Table I—Cont.	Quan.	A	B	C
11	Pumping (unit fixed price) M. ft. gal.	$250,000	$0.10	$0.10	$0.10
12	Observation Pipe wells, l.f.	1,000	2.50	3.50	2.65
13	Earth exc. corewall to El. 310, c.y.	30,000	5.85	6.50	8.72
14	Earth exc, corewall below El. 310, c.y.	3,000	13.00	6.50	17.32
15	Rock exc. in caissons to El. 310, c.y.	2,000	9.00	1.00	30.00
16	Rock exc. in caissons below El. 310, c.y.	700	14.00	1.00	40.00
17	Rock exc. in corewall outside caissons, c.y.	200	8.00	10.00	10.00
18	Prep. rock surface in caissons above E. 310, s.y.	600	2.00	2.00	5.00
19	Prep. rock surface in caissons below El. 310, s.y.	700	5.00	2.00	6.00
20	Prep. rock surface outside caissons, s.y.	400	1.00	2.00	1.00
21	Concrete placed in free air, c.y.	42,000	5.60	7.00	5.05
22	Concrete placed under air, c.y.	7,500	5.50	4.00	6.22
23	Impervious filling in caissons, c.y.	4,000	1.00	1.00	.20
24	Impervious filling corewall outside caissons, c.y.	600	.65	1.00	1.00
25	Drilling holes in rock or masonry, l.f.	7,000	1.00	.75	2.00
26	Furnishing and placing grout, c.y.	1,000	7.00	8.00	10.00
27	Portland cement, bbl.	85,000	2.70	2.20	2.38
28	Riprap, c.y.	6,000	2.50	.50	2.00
29	Cobble gutters, s.y.	2,500	.65	.50	1.75
30	Guard rail, l.f.	2,600	.50	.45	.35
31	Pipe culverts, l.f.	500	2.50	1.65	1.75
32	Engineers office, lump sum	.....	3,150	5,000	2,800
33	Cleaning up, lump sum	.....	1,000	1,000	2,556
	Total bid		$999,265	$1,065,595	$1,133,255


Open trench to rock
25' core wall in open trench
Core wall built by sheeting
Caisson limits
Sta. 27+70
Top of corewall
Sta. 14+83
Original surface
Top of corewall
Bottom of open-cut trench
Sound bed rock
Caisson No 13 already in place
Caissons 7, 13 and 18 will be pump wells
Grout holes as directed
Elevation
520
500
480
460
440
420
400
380
360
340
320
300
280
15+00
20+00
25+00
30+00
Station
Looking upstream

LONGITUDINAL SECTION OF COREWALL


18"
B
10'-6"
12'
18"
4' diam
Muck well
B
Man well
Muck well
Plan of Caissons
45'
9' average
Ladder
Bottom of open trench
Asphaltic material on sloping faces
18" 18" 18"
4'
9' average
Steel cylinder anchorage for air lock
Method of Sealing Caissons End to End
6'6"
Working chamber
Pipes for drilling grout holes
Section A-A
Sec. B-B

DETAILS OF TYPICAL CAISSON

TABLE II — COMPLETE LIST OF BIDDERS AND UNIT PRICES OF PRINCIPAL ITEMS

	List of Bidders	Unit Prices of Items									Total Bid
		1	7	8	13	14	15	21	22	27	
1	West Const. Co., Boston	$0.19	$0.12	$0.36	$5.85	$13.00	$9.00	$5.60	$5.50	$2.70	$999,265
2	C. & R. Const. Co., Roslindale, Mass	.50	.05	.25	6.50	6.50	1.00	7.00	4.00	2.20	1,065,595
3	J. F. Fitzgerald Const. Co., Boston	.22	.11	.18	8.72	17.32	30.00	5.05	6.22	2.38	1,133,265
4	Brader Const. Corp., New York	.30	.07	.30	11.00	11.00	12.00	7.15	7.15	2.25	1,210,495
5	J. J. Coughlan & Sons, Boston	.26	.07	.53	10.30	12.00	11.50	6.30	6.60	2.50	1,214,928
6	Nicholas Di Menno, New York	.22	.20	.20	5.60	8.00	20.00	9.00	13.00	2.25	1,251,250
7	Cenedella & Co., Milford, Mass	.18	.085	.54	11.90	23.00	1.00	5.00	8.50	2.15	1,251,590
8	Wensel & Henoch Const. Co., Gilbertville, Mass	.18	.07	.30	7.84	16.30	35.00	7.80	11.50	2.30	1,261,050
9	Brewster Const. Co., Bogota, N. J	.20	.08	.55	11.70	11.70	6.00	7.05	8.75	2.52	1,262,685
10	Booth & Flinn Co., Pittsburgh	.20	.07	.53	13.20	16.00	14.30	6.60	6.30	2.00	1,263,163
11	The Carleton Co., Inc., New York	1.72	.10	.30	2.60	3.60	4.60	4.25	7.00	2.50	1,292,325
12	Northern States Const. Co., Elizabeth, N. J	.28	.07	.41	4.39	11.50	20.70	10.60	10.60	2.94	1,300,462
13	The Foundation Co., New York	.20	.07	.50	8.00	15.00	16.00	10.65	4.90	2.50	1,336,510
14	Geo. H. Flinn Corp., New York	.50	.60	.42	9.00	12.00	9.45	5.35	9.70	2.25	1,373,985
15	Arthur McMullen Co., New York	.19	.06	.44	14.31	24.30	25.85	7.20	7.80	2.36	1,408,019
16	The Geo. R. Cooke Co., Detroit	.23	.12	.50	13.00	13.00	15.00	9.00	9.00	2.20	1,437,595
17	J. H. Ferguson Co., Providence	.40	.15	.40	15.15	12.12	20.00	5.21	7.21	2.33	1,502,515
18	The Dravo Const. Co., Pittsburgh	.17	.07	.50	10.75	24.00	35.00	12.00	18.00	2.50	1,573,060
19	Rodgers & Hagerty, Inc., New York	.60	.12	.36	20.20	20.20	20.20	10.25	10.25	2.15	1,760,055
20	Cornell Contr. Corp., New York	.22	.45	.70	24.00	30.00	22.00	4.50	7.00	2.80	1,868,820
21	Marcus Contr. Co., Inc., New York	.58	.25	.76	17.90	20.00	20.00	7.75	8.50	2.19	1,925,000
22	Merritt-Chapman & Scott, New York	.50	.35	.40	13.50	30.00	15.00	15.00	15.00	2.20	1,945,100
23	Silas Mason & Co., Inc., East Boston	.30	.10	.60	18.80	32.00	18.80	15.00	18.00	2.50	2,127,500
24	Spencer & Ross, Inc., Detroit	1.15	.15	.30	18.00	30.00	20.00	12.75	16.00	1.95	2,188,800
25	Peter F. Connolly, Brooklyn	.73	.50	.80	21.41	35.54	20.16	12.91	13.00	2.43	2,344,177